Infection Control Driven Antibiotic Stewardship in a Long-term Care Facility

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Abstract

Antibiotic have contributed to the decline in mortality and morbidity caused by infections, but overuse may weaken effectiveness resulting in a worldwide threat. Antibiotic overuse is correlated with adverse events like *Clostridium difficile* infection, antimicrobial resistance, unnecessary healthcare utilization and poor health outcomes. Long term care facility (LTCF) residents are vulnerable targets for this phenomenon as antibiotics are one of the most commonly prescribed medications in this setting. Consequently, multiple organizations mandate strategies to promote antibiotic stewardship in all healthcare sites particularly LTCFs. To address this global issue, this doctoral project utilized the Outcomes-Focused Knowledge Translation intervention framework to provide sepsis education, promoted use of an established clinical algorithm and engaged a communication tool for nurses and the certified nursing assistants (CNAs) thus, improving antibiotic stewardship. The project was conducted in a 5-star Medicare-rated LTCF in Mesa, AZ with a convenience sample of 22 participants. The participants received a knowledge questionnaire and Work Relationship Scale pre- and post- intervention to determine improvement. The results show that education provided did not improve their knowledge with a $p = 0.317$ for nurses and for CNAs $p = 0.863$ over 8 weeks. Lastly, education provided did not improve the nurses' Work Relationship $p = 0.230$ and for CNAs $p = 0.689$. Though not statistically significant, the intervention tools are clinically significant. Additional research is needed to identify ways to determine barriers in implementing an antibiotic stewardship program.

Keywords: Antibiotic Resistance, Antibiotic Stewardship, Long Term Care Facility

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Since the discovery of antibiotics, there has been a decline in mortality and morbidity caused by infections; however, unnecessary administration and prescription of antibiotics has led to a crisis in healthcare, as rising volumes of infections are becoming resistant, thus becoming more difficult to treat (World Health Organization [WHO], 2018). Antibiotics are one of the most commonly prescribed medications in long term care facilities (LTCFs); these can be detrimental to the frail elderly if prescribed inappropriately (Centers for Disease Control and Prevention [CDC], 2018). Antibiotic resistance (AR) develops when a harmful microbe alters the efficiency of antibiotics (U.S. Food and Drug Association, 2018). Consequently, developing ways to improve antibiotic prescribing in healthcare facilities to counteract AR has been a national priority.

The CDC (2018) urges all LTCFs to promote AS which is a set of duties and activities intended to enhance infection management while decreasing the harmful results caused by antibiotic use. AS protects residents by using the seven core elements which are needed to effectively implement ASP and take steps to improve antibiotic prescribing practices. Methods taken to promote AS in LTCFs has been promising but differ in results (Daneman et al., 2017). Therefore, when providing infectious disease treatment to the LTCF residents, healthcare providers must consider patient safety, staff knowledge and the antibiotic need.

Problem Statement

Antibiotics have been prescribed extensively in LTCFs where 70% of the residents get one or more courses of systemic antibiotics in a year but 40-75% of antibiotics prescribed were unnecessary (CDC, 2017). Inappropriate antibiotic prescribing has led to resistant flora and the likelihood that the infection will spread due to close contact of those exposed to other people

(Fleming, Bradley, Cullinan, & Byrne, 2015). The following are results of antibiotic misuse: Infections such as *Clostridium difficile (C. difficile),* multidrug resistant organism, adverse effects of antibiotics, interactions with other medications, rising medical costs, longer hospital stays and mortality are all potential adverse effects of antibiotic misuse (CDC, 2017; WHO, 2018). According to Thorpe et al. (2017), the estimated national cost of treating patients with an antibiotic resistant infection would be $2.2 billion annually which also explains why there is a great need for innovative infection prevention and treatment programs, antibiotic stewardship and vaccinations as international priorities. Furthermore, it is estimated that by 2050, 10 million deaths will be associated with AR (O'Neill, 2016).

The United Nations (2016) declared that best practice for managing infections is improved awareness on AR. In 2016, the U.S. Congress granted $160 million to the CDC to execute Antibiotic Resistance Solutions Initiative and promote AS (CDC, 2018). The Center for Medicare and Medicaid Services (2018) included the provision of antibiotic stewardship programs (ASPs) as part of their LTCF requirements to practice safe healthcare delivery effective on 2016. Although, Crnich et al. (2015) states that while multiple projects from various institutes have been recognized, LTCFs face multiple challenges in applying ASPs.

As part of ASP, Eke-Usim and colleagues (2016) suggest that antibiotic prescribing patterns in LTCFs can be enhanced by using interventions focused on local patterns, determinants and outcomes of antibiotic use. Since the antibiotic prescribing process in LTCFs is different from the hospital and clinical setting, implementation of effective AS has been difficult. The nursing staff have the utmost contact with residents and can make a significant impact in AS research, practice, policy making, and education (Manning, & Pogorzelska-Maziarz, 2018).

Thus, the quest for determining how nurses can effectively manage infections in LTCFs to ensure patient safety is still unidentified.

Purpose and Rationale

Antibiotic resistance has stemmed from impractical use of antibiotics which continues to affect LTCF residents. Consequently, the government and multiple healthcare organizations have advocated the use of AS. Implementing any method to correct antibiotic use may decrease resistance, leading to better outcomes for these residents. Since many LTCF residents are frail and nursing staff have the most contact with them, the purpose of this project is to provide education on sepsis prevention and early identification, use of an established clinical algorithm, and inclusion of communication support for LTCF nursing staff to improve AS in the long term care setting.

Background and Significance

Antibiotics have saved multiple lives in combating infection-causing microbes but can also cause adverse reactions leading to resistance (Frieri, Kumar & Boutin, 2017). At the cellular level, bacteria develop resistance by following orders given by their DNA and transmitting these signals to another microorganism (Alpert, 2017; CDC, 2019). These microbes may limit access of the antibiotic by changing their cellular walls, remove antibiotics using pumps in their cell walls, destroy these microbes with enzymes and defeat the mechanism of the drug. These microbes may also develop new cell processes that bypass the effects of the antibiotics or altering the target for antibiotics (Fieri, Kumar & Boutin, 2017; CDC, 2019). Conversely, antibiotic resistance occurs because antibiotics are utilized in animals to stimulate growth, making bacteria in their gut accustomed to the antibiotic and resistant pathogens can be transmitted to humans (Alpert, 2017).

Long Term Care Facilities

Long term care Facilities (LTCFs) provide healthcare services and support for the frail and dependent elderly in accomplishing their activities of daily living. Of all healthcare facilities, LTCFs have the highest rates of inappropriate prescribing related to dosage, duration, and when to start and stop antibiotics (Nguyen, Tunney & Hughes, 2019). It is estimated that 1.4 million older adults living in American nursing homes are at a high risk for multi-drug resistant organisms due to antibiotic overuse and misuse which is about one in three nursing home residents (Feldstein, Sloane & Feltner, 2017). In fact, majority of LTCF residents are vulnerable (CDC, 2013) and are at high risk for obtaining infection due to immunosuppression, functional and cognitive impairment. Even more, the residents themselves and the nursing staff failure to communicate symptoms, may lead to assumptions in the need for antibiotic prescribing (Van Buul et al., 2015).

The United Nations (2016) declared that best practice for managing infections is improved awareness on antibiotic resistance. In 2016, the U.S. Congress granted $160 million to the CDC to execute Antibiotic Resistance Solutions Initiative and promote AS (CDC, 2017). Although, Crnich et al. (2015) states that while multiple projects from various institutes have been recognized, nursing homes face multiple challenges in applying antibiotic stewardship programs. Thus, Feldstein, Sloane and Feltner (2017) confirms that there is a need for a judicious approach in antibiotic prescribing.

Nursing Staff

The nursing staff, both CNAs and nurses, are the only licensed healthcare professionals available on-site 24 hours a day in many LTCFs and only 44% of residents who received antibiotics were physically seen by a provider within one day of prescription (Morrill et al.,

2016). Hence, providers who are mostly off-site and spend only 8-12 hours onsite a week per LTCF, rely most heavily on the nurses' evaluation (Katz et al., 2017; Morrill et al., 2016). A survey conducted in Rhode Island demonstrated that approximately 80% of facilities did not have full-time infectious disease providers facility-wide (Morrill et al., 2016). Furthermore, the residents and the families' expectations play a vital role in antibiotic prescription. In this case, Scales et al. (2016) found that nurses are optimistic toward reducing antibiotic use but have a stronger perception than clinicians that residents and families prefer antibiotics, affecting prescribing decisions. This is influenced by a general fear of litigation on the part of the provider resulting to more aggressive care and unnecessary hospital transfers. Therefore, as front-line members in providing patient care, supporting the nursing staff poses great opportunities for ASP (Abbas et al., 2019).

Guideline-adherent Antibiotic Use for Treatment of Infections

Van Buul et al. (2015) affirms that antibiotic prescribing decisions depend on numerous factors -- clinical situation, advance care plans, diagnostic resources, clinicians' perceived risks, social and environmental factors which may vary between LTCFs. Thus, a substantial variation in organizational structures and intervention in ASP affect approaches and policies for optimal antibiotic use (Feiring & Walter, 2017).

Nace et al. (2018) affirms that implementing clinical guidelines in LTCFs is challenging. However, using an algorithm to manage diseases such as uncomplicated cystitis in LTCFs, can promote AS. Feldstein, Sloane and Feltner (2018) found that the efficacy of some ASP in LTCFs is encouraging but limited. Either way, ASP can reduce antibiotic prescriptions and improve health outcomes. However, more research is desired to verify which programs will enhance LTCF residents' health and which ASP are deemed effective.

Healthcare Provider Knowledge, Patient Safety and Antibiotic Use

Empowering the nursing staff to be antimicrobial stewards can help cut unnecessary antibiotic use in long term care facilities (LTCFs) (Katz et al., 2017; Wilson et al., 2017). Most LTCF nurses are aware of the dangers of antibiotic use and exhibits evidenced-based behaviors and attitudes to prevent it. Still, more effort is vital to improve the knowledge in AS and promote patient safety (Kistler et al., 2017). In fact, one AS intervention may cut antibiotic use for two years after initiation by linking education with feedback on clinician prescribing practices (CDC, 2015). As a result, there is a 64% decline in unnecessary antibiotic use just by offering feedback on the clinician prescribing practices and adherence to the guidelines over a year (Lim et al., 2014).

As a whole, antibiotic resistance (AR) has been a global issue which resulted in the creation of antibiotic stewardship programs (ASPs). In view of LTCF nursing staff playing a vital role in preventing AR and their participation with promoting guidelines in managing infections, it is still unknown if it would affect healthcare provider knowledge, patient safety and antibiotic use.

Internal Evidence/ Setting generated data

A long term care facility (LTCF) in Mesa, AZ adapted their internal antibiotic stewardship program (ASP) in January 2018. The key stakeholder reports the facility continues to have difficult time lowering facility infection rates despite increasing hand sanitizer stations, education on isolation precautions and updating their sepsis protocol. The nursing staff were interviewed and were not aware of any AS activities promoted in the facility, facility-specific algorithms on assessing residents, and the specific reports on antibiotic use and outcomes with

clinical providers and nursing staff. Therefore, interventions linking infectious disease guidelines education coupled with teamwork support, may progress in expanding their ASP.

PICOT Question

The elderly population has been rising drastically with a considerable growth of 48% in people aged 60 or over between 2000 and 2015, which may increase to 1.4 billion in 2030. Majority of the elderly population reside in nursing homes were unnecessary antibiotic prescribing is rampant causing antibiotic resistance. This can heighten medical costs, prolong course of antibiotics and cause adverse reactions like *C. difficile*. Hence, multidrug resistant organism transmission is intensified due to limited resources to identify acute bacterial infections like diagnostic testing and imaging, heavier nursing staff-to-resident ratios, inadequate medical equipment and shared rooms in nursing homes (Feldstein, Sloane and Feltner, 2017). The United States government has proposed the need to improve nursing home systems to meet the growing necessities of the elderly while preserving their safety and well-being (Nguyen, Tunney, & Hughes, 2019). One of the strategies suggested by Morrill and colleagues (2016) is to use educational trainings as these have been mostly successful at improving antibiotic use for the management of infections. Examples of these approaches include educational sessions, academic detailing, prescribing feedback, dissemination of written materials like guidelines, algorithms, pocket cards, posters and toolkits. Although, strategies to advocate antibiotic stewardship in nursing homes has been promising, it may vary in results.

Preliminary interest in this problem led to an inquiry of current evidence to determine the best interventions for antibiotic stewardship. The preceding review of the literature has led to the following PICOT question: In long term care facility nursing staff (P), how does following a

sepsis algorithm for managing associated infections (I) compared to current practice (C) affect nursing staff knowledge (O) over three months (T)?

Search Strategy

An exhaustive search of medical and nursing literature was done to classify all pertinent articles that offered evidence to address the PICOT question. This was completed by searching for references in bibliographic databases and ancestry approach. Inclusion criteria comprised of (a) articles published from 2014 to 2019, (b) adult residents aged 45 and above, (d) written in English, (e) academic or peer-reviewed journals that include abstracts and full text and (f) based on primary and secondary data analysis. The databases that were utilized include CINAHL, Cochrane Library and PubMed. Keywords contained the following: long term care facility, nursing home, nursing assistant, nurse, nursing staff, guideline, algorithm, infection, management, antibiotic use, antimicrobial, antibiotics, antibiotic Resistance, antibiotic stewardship, antimicrobial stewardship, and stewardship. The research evidence searches started on March 10, 2019 and ended on March 11, 2019.

Initially, the combination of terms yielded 51,009 results in CINAHL, but after applying the inclusion criteria, total results yielded 44. Furthermore, searching through Cochrane Library, the combination of terms yielded 135 Cochrane Trials and 6300 Cochrane Central Register of Controlled Trials, but after using the inclusion criteria, the list went down to 65 Cochrane Reviews and 453 for the clinical trials. Lastly, after using the mixture of keywords in PubMed, 85,931 articles were found during the initial search. After setting the inclusion criteria, 30 articles were shown.

After thorough critical appraisal of the resultant literature, 10 articles were selected for use in the evidence table.

Critical Appraisal and Synthesis of Evidence

The Melnyk and Fineout-Overholt's (2019) rapid critical appraisal was used to evaluate the quality of the 10 articles chosen for this literature review. The majority of the studies were high-level evidence, including four Literature Reviews (LRs), one randomized controlled trial (RCT), three the clustered randomized controlled trials (cCRTs) and a longitudinal cohort study derived from a cRCT. However, Van Buul et al. (2015) is the sole study that is derived from a mixed method, quasi-experimental method and is unblinded with the randomization of subjects (Appendix A). Two studies provided a theoretical or conceptual framework while the funding sources are reported in all studies and there is no identified bias in seven out of 10 researches. The sample size is adequate in all studies. The majority of the studies were completed in the United States. Furthermore, the interventions were carried out in LTCFs and the number of LTCFs per study was >10.

There is a wide variety of instrumentation used in measuring the outcomes and intervention designs which varied due to setting location and healthcare system involved. Despite the significant heterogeneity within these variables, commonalities existed. The results show that the application of ASPs particularly using guidelines, education, infection control and multidisciplinary consults are effective measures to reduce unnecessary antibiotic prescriptions LTCFs. Statistically significant results and high-quality measurement tools propose robust reliability and validity. Results on all RCTs have a *P* value of <0.05 claiming that there is a significance in using ASP in reducing antibiotic prescriptions (Appendix B).

Conceptual Framework Application

Having access to current and reliable resources of information is a challenge for the nursing staff in LTCFs hence, facilitating appropriate decision making based on these evidences

has been lacking. The Promoting Action on Research Implementation in Health Services (PARIHS) model suggests an up-to-date evidence integration based on its nature, the context of the desired change and the mechanism of the facilitating change. According to Zaccagnini & White (2014), this model has been revised multiple times. Doran and Sidani (2007) identified the gaps of the PARIHS model and formulated the Outcomes-Focused Knowledge Translation Framework. The Outcomes-Focused Knowledge Translation intervention framework (Appendix C) is designed to continuously improve patient care and practice change. This comprises of four components: a) patient outcomes measurement and actual feedback about results success; (b) best-practice guidelines, rooted in decision support tools that convey key ideas in response to patient assessment data; (c) clarification of patients' preferences for care; and (d) facilitation by advanced practice nurses and practice leaders (Doran & Sidani, 2007).

The application of this conceptual model to antibiotic stewardship (AS) in long term care facilities (LTCFs) may help the nursing staff have access to data when most need for clinical decision making. Actively learning about the current guidelines on antibiotic use and infection control while considering the residents' preferences and real-time feedback can promote AS. This will help create interventions suitable for the LTCF's culture and organization resulting in a continuously enhanced patient care.

Evidence Based Practice Model

There is a growing demand for healthcare and nursing organizations to design methods in promoting the use of Evidence-based practice (EBP) to aid in decision making. EBP incorporates a high-quality scientific evidence with the most reliable empirical evidence (Dang & Dearholt, 2018). Therefore, using an EBP model to guide change, may enable excellence in the expansion of patient care outcomes (Moran, Burson & Conrad, 2018) by combining research,

organizational experience, clinical expertise and patient preferences (Dang & Dearholt, 2017). Since the nursing staff has significant influence on healthcare decisions, EBP provides them an opportunity to enhance practice and patients' quality of life. Consequently, the Johns Hopkins Nursing Evidence-based Practice (JHNEBP) Model was initially proposed as a clinical decision-making model for bedside clinical nurses but has shown to be efficient in answering functional, educational and administrative questions (Poe & White, 2010). The revised JHNEBP model (2017) comprised of three interrelated components: inquiry, practice, and learning which is intended explicitly to meet the needs of the practicing nurse (Appendix D). This model applies a three-step process called PET practice question, evidence, and translation (Appendix E). The goal of the model is to ensure that the latest research evidence and best practices are rapidly and suitably integrated into patient care.

Using the JHNEBP Model in the application of AS in LTCF, curiosity to determine whether the current practice reflect the best practice can spark healthcare improvement and change. Following the PET process as a systematic approach for finding a suitable evidence and translating it into practice, there is a continuity in learning and collaboration. This may generate a new EBP process and promote behavior changes to ameliorate the system impacting the nurse and patient outcomes.

Methods

Ethical Considerations and Human Subject Protection

This project obtained ethical approval by Arizona State University's Institutional Review Board on September 12, 2019. All study participants provided an informed consent prior to taking part in the project. Paper copies of the demographic forms and pre- and post-

questionnaires were protected by co-investigator in a locked cabinet and were shredded after data was recorded into the Intellectus Statistics™ for analysis.

Description of population and setting

This project was implemented in a long term care facility located in Mesa, Arizona and was granted a 5-star overall rating by Medicare. This organization provides behavioral care, memory care and skilled nursing. The skilled nursing unit was the focus of the study because residents will receive the greatest benefit from this project due to their complexity of the diseases and the increased risk for infections in this population. The nursing staff were the participants of this project. Inclusion criteria included ages greater than 18 years, was fluent in English, can read and write, and was employed as a nurse (Registered Nurse or Licensed Practical Nurse) or a CNA in the said LTCF.

Practice Changes to be Achieved

The intervention included and the education session was about infection control, (antibiotic stewardship) AS and sepsis. The designed sepsis protocol and algorithm was utilized throughout the course of the project and an SBAR (Situation, Background, Assessment, Background) communication tool was used to promote improved interaction throughout the healthcare team. This communication or SBAR tool was tailored to the nurses and the CNAs. Continuous feedback from the nursing staff, nursing administration and the clinicians is needed to encourage constant exchange of ideas to advocate for adherence to protocols that improve AS.

Instrumentation, Data Collection, and Data Analysis Plan

At the start of the project, demographic information and a brief questionnaire is collected. There are two types of questionnaires: a questionnaire that would determine the nursing staff's knowledge about infection, AS, use of the sepsis protocol and algorithm; and secondly, the Work

Relationship Scale by Finley et al. (2013). The knowledge questionnaire was validated by three experts on infection control and sepsis and is individualized for nurses and for CNAs following the LTCF's organizational culture. The knowledge questionnaire is a true or false questionnaire. The Work Relationship Scale by Finley et al. (2013), a Likert-scale type questionnaire, was chosen to assess the organization's quality of relationships as it plays a vital part in influencing care delivery in an attempt to develop better patient care within primary care settings. The reliability of the Work Relationship Scale is high with an internal consistency of Cronbach's $\alpha = 0.95$. The nurses' and the certified nurse assistants' knowledge questionnaire, Work Relationship Scale and a post-intervention survey was administered to determine any changes or improvement after the implementation. The post-intervention survey would determine the personal impact of the training to the nursing staff with regards to their knowledge, communication and work relationship. This survey is a Likert-scale type questionnaire and open-ended questions.

The data was stored and analyzed using Intellectus Statistics™. Descriptive statistics was utilized to describe and analyze the demographic data and the post intervention survey. The pre-test and post-test Knowledge questionnaire and the Work Relationship Scale scores were calculated for each participant. For these, a two-tailed Wilcoxon signed rank test was conducted to examine whether there was a significant difference between pretest and posttest scores. The two-tailed Wilcoxon signed rank test is a non-parametric alternative to the paired samples t-test and does not share its distributional assumptions.

Project Description and Timeline

Before the start of the intervention, a meeting with the nursing administration was conducted to discuss the updated facility sepsis protocol and process of implementation. A letter of support from the Director of Nursing was obtained (Appendix F). The project was carried out

over 12 weeks. Participants were recruited through invitational flyers throughout the breakroom and the nursing unit (Appendix G). After a week of recruitment, participants were screened based on the eligibility criteria. Eligible participants were approached personally to review an approved cover letter with project details (Appendix H). If a participant agrees, completion of the demographic sheet (Appendix I), and pretest using the Work Relationships Scale by Finley et al. (2013) (Appendix J), and a knowledge questionnaire (Appendix K for nurses and Appendix L for CNAs) that would assess familiarity on infection control, AS and the use of the sepsis algorithm. Following pre-testing, an individually tailored educational session was provided either all in one session or delivered in shorter intervals as the nursing staff workday allowed for a total of 30 minutes of education. The educational protocol included the sepsis definition, clinical signs and symptoms, the role of the nursing staff in preventing Sepsis and how this becomes a start of AS, the updated sepsis protocol (Appendix M) and algorithm (Appendix N). The updated sepsis protocol used in this project was based from the Minnesota Hospital Association's (2019) Seeing Sepsis Skilled Nursing Facility Sepsis algorithm for adults. To make it more individualized to the project site, approval from the nursing administration was acquired. In addition, the SBAR tool used in this project was tailored to be used by either a nurse or CNA, to cater to their responsibilities and roles (Appendix O for nurses and Appendix P for CNAs). Moreover, frequent visits to the project site was conducted to obtain real time data on the progress of the intervention to get feedback or answer any questions from the nursing staff.

Eight weeks post-intervention, a closure assessment entailing a review of goal achievement and discussion of areas that still need improvements was discussed. The participants took the Work Relationship Scale and posttest questionnaire to evaluate the effectiveness of the education provided. A healthcare team satisfaction survey was then

administered to the nursing staff involved with the program to assess satisfaction with the Sepsis protocol and AS intervention (Appendix Q).

Budget and funding received

Budget Justification

A locked file cabinet was purchased to promote nursing staff privacy on all documents acquired during the implementation of the project and was stored in the co-investigator's home. Intellectus Statistics™ is the statistical package that was used to store and analyze the data. Writing materials (pens) were utilized for those who are going to take the pre-test and post-test. Pre-test and post-test questionnaires were needed to determine nursing staff's knowledge; while banners or signs, laminated ID reminders and handbook were useful resources for the nursing staff. Educational handouts and pamphlets were utilized as part of the training session (Appendix R).

Potential Revenue or Cost Savings

By promoting infection control and (antibiotic stewardship) AS through educating the nursing staff, there will be a decrease in need for expensive antibiotic administration, insertion of intravenous (IV) lines (central/peripheral), use of equipment like IV pumps, syringes, IV fluids; frequent monitoring of the resident, provider consultations, a need for higher level of care or even worse, hospitalization which can lower unnecessary medical costs and services. A study conducted by Roberts et al. (2009) confirmed that a patient who gets admitted in a hospital with an antibiotic resistant infection would have to pay $2098 per day. Furthermore, it is estimated that the medical cost of patients with an antibiotic-resistant infection range from $18,588 to $29,069 (Ventola, 2015). Therefore, there is a need for robust AS and infection/Sepsis control should be implemented to prevent lesser health outcomes and unnecessary medical expenses.

Funding

There was no funding received during the course of this doctoral project.

Results

Outcomes

Participants

The demographic data of the participants were obtained (Appendix S, Table 1). The total number of participants who met the criteria were 22. The average age of the participants is 33 years old (SD=10.87). There was a total of 18 females (81.82%) and 4 males (18.18%). Majority of the participants were Caucasian (n=10, 45.5%), 22.7% were African Americans (n=5), 18.2% were Hispanic (n=4); 13.6% considered themselves to have mixed races (n=3) and there were no Asians, Native Americans or Pacific Islanders. Half of the participants were single (n=11), 40.91% were married (n=9) and 9.09% were divorced (n=2). Fifteen (68.18%) participants finished their Associate degree, four (18.18%) completed a Bachelor degree and three (13.64%) were high school graduates. More than half (n=12; 54.55%) were CNAs, there were 6 (27.27%) Licensed Practical Nurses and 4 (18.18%) Registered Nurses. All of them worked fulltime (n=22; 100%). Fifteen (68.2%) out of 22 worked during the night shift (from 1900-0700) and seven (31.8%) worked during the day. 31.6% of the participants (n=7) had 1-3 years of experience working in their respective nursing position, 22.7% (n=5) worked 10-20 years, 18.2% (n=4) worked 3-5 years and those who worked less than 1 year and 6-10 years were both 13.6% of the participants.

The participants (N=22) were asked prior to the education if they were provided educational resources about infection control and antibiotic resistance by the facility and 45% (n=10) of them said yes and 55% (n=12) said no (Appendix S, Figure 1). In addition, they were

also asked if the facility provided opportunities for nursing staff to be part of antibiotic stewardship and majority 45% (n=10) said yes and 55% (n=12) said no (Appendix S, Figure 2).

Nursing Staff's Knowledge Rating on Antibiotic Stewardship and Infection Control

The results of the two-tailed Wilcoxon signed rank test for the nurses' knowledge rating on antibiotic stewardship and infection control were not significant based on $\alpha = 0.05$, V = 2.50, z = -1, $p = 0.317$ (Appendix S, Figure 3). This indicates that the differences between pretest (Mdn = 2.00) and posttest (Mdn = 3.00) are explainable by random variation. However, for CNAs, the results of the two-tailed Wilcoxon signed rank test were not significant based on $\alpha = 0.05$, V = 7.50, z = -1, $p = 0.317$. This indicates that the differences between pretest (Mdn = 2.00) and posttest (Mdn = 2.00) were explained by random variation (Appendix S, Figure 4). Therefore, the nursing staff's knowledge rating regarding infection control and AS did not improve.

Nursing Staff Knowledge Questionnaire

The results of the two-tailed Wilcoxon signed rank test for the nurses' knowledge were not significant based on $\alpha = 0.05$, V = 0.00, z = -1, $p = 0.317$ (Appendix S, Figure 5). This indicates that the differences between pretest score (Mdn = 12.00) and post test Score (Mdn = 12.00) were explained by random variation. Whereas the CNAs', the results of the two-tailed Wilcoxon signed rank test were not significant based on $\alpha = 0.05$, V = 15.00, z = -0.17, $p = .863$ (Appendix S, Figure 6). This indicates that the differences between pretest score (Mdn = 7.00) and post test score (Mdn = 7.50) were explained by random variation. Therefore, the educational training provided did not improve the knowledge of the nursing staff.

Nursing Staff Work Relationship

The results of the two-tailed Wilcoxon signed rank test for the nurses' Work Relationship were not significant based on $\alpha = 0.05$, V = 19.50, z = -1.20, $p = 0.230$ (Appendix S, Figure 7).

This indicates that the differences between pretest Work Relationship score (Mdn = 46.00) and posttest Work Relationship score (Mdn = 53.90) were explained by random variation. The CNAs' Work Relationship results of the two-tailed Wilcoxon signed rank test were not significant based on $\alpha = 0.05$, V = 28.50, z = -0.40, $p = 0.689$ (Appendix S, Figure 8). This indicates that the differences between the pretest Work Relationship score (Mdn = 53.50) and the posttest Work Relationship score (Mdn = 51.50) were explained by random variation. Therefore, the educational training provided did not improve the nursing staff's Work Relationship.

Post-intervention Survey

Though not statistically significant, the intervention tools were clinically significant. The sepsis protocol and algorithm has become part of the guidelines used in the said (long term care facility) LTCF. The nurse and CNA SBAR tool have been encouraged to be utilized as part of their communication with the providers and other healthcare workers involved in the care of a possible septic resident. Majority of the nursing staff agreed that the training helped enhance their organization's knowledge of sepsis (n = 9, 75%), greater awareness of sepsis symptoms, severe sepsis and septic shock (n = 11, 50%); better recognize which resident is at higher risk for sepsis (n = 14, 64%) and understand the treatment of sepsis (n = 11, 50%) (Appendix Q). Moreover, the nursing staff agreed that they have a sense of personal responsibility for improving resident care and outcomes (n = 13, 59%) and developed a trusting relationship with their co-nursing staff because of a better communication strategy (n = 13, 59%). There are mixed thoughts on the use of the SBAR tool since half of the participants thought that it might have helped them communicate better with the healthcare team and the others said it may not have helped (*n* = 9, 41%). When the nursing staff was interviewed regarding this question, they said that they do not have enough time to use it consistently because of the workload that they have

with just minimal time. Based on the results of the survey, the nursing staff use the SBAR tool rarely or 2-3 times per month (M = 1.77; SD = 1.34). However, they agreed (n = 10, 45%) that the SBAR tool has guided their day-to-day communication with the healthcare team. On the last page of this survey were questions about how to improve the training session. One CNA noted that it would be better if they can have frequent trainings regarding infection control and follow-up from nursing leadership. Another CNA stated that the training session would be effective if it will be implemented in the whole LTCF so that when they get floated to a different unit, there is no confusion regarding proper guidelines and protocols. In addition, a nurse encouraged the educational session be scheduled during change of shift to get more participants. Lastly, two nurses were thankful that they learned a lot from the educational training.

Impact of the project

LTCF Residents

The impact of the doctoral project to the long term care facility (LTCF) residents is extensive because this could avoid unnecessary futile healthcare utilization like hospitalizations, diagnostic laboratory services, medical imaging, antibiotic administration etc. Since antibiotic misuse can cause infections like *C. difficile*, multidrug resistant organisms, adverse effects of antibiotics, interactions with other medications, rising medical costs, longer hospital stays and mortality (CDC, 2017; WHO, 2018), an in-depth education regarding sepsis, infection control and AS is needed to promote quality of life of these residents.

Providers

This project has impacted the long term care facility (LTCF) staff particularly the nursing administration, nurses, CNAs and providers as well. Empowering the nursing staff to be part of any ASP can contribute to lessening unnecessary antibiotic use in LTCFs (Katz et al., 2017;

Wilson et al., 2017). The nursing staff have strong roles in impacting treatment management for residents in nursing homes but, they have misconceptions about infections and consider that antibiotics are needed more often for these residents (Sloane et al., 2016). While it is true that the nursing staff are considered the forefront providers who care for the residents, they also act as their main communicators for the clinicians, other healthcare providers and family members. Therefore, improving the nursing staff's knowledge about evidence-based algorithms such as a sepsis protocol in caring for residents with infection, develops the nursing staff confidence in engaging with more ASPs. Inspiring the nursing staff to be antibiotic stewards may help decrease unnecessary use of antibiotics among LTCF residents (Wilson et al., 2017).

This project can impact nursing staff and the nursing administration. A logic model is provided to identify outcomes and impacts to the project site (Appendix T). The nurses have increased knowledge regarding sepsis, antibiotic use, the importance of following the updated sepsis protocol and algorithm and improve communication with the other healthcare providers. Certified nurse assistants also have increased knowledge on sepsis, antibiotic use promote better communication by providing vital resident observations to nurses. In addition, the nursing administration should also be involved for sustainability. The nursing administration have monitored and performed a comprehensive check via meetings and foster organizational teamwork to improve staff knowledge, resident safety and antibiotic use.

System

The need for a multidisciplinary team in charge of antibiotic stewardship (AS) and infection control is essential to endorse better adherence and counteract antibiotic resistance. The CDC (2017) has suggested that LTCFs should at least have leaders who reinforce AS in their facility through written statements, provision of guidelines and policy making. The accessibility

of an infection control preventionist in each LTCF is required to operate with a provider or a pharmacist to advocate for their AS demands. One study emphasized in Morrill et al.'s (2016) structured review is that there was a significant decrease in total antibiotic use when an infectious disease physician and nurse practitioner were available on-site weekly and remotely on the remainder of the week. Moreover, the rate of confirmed *C. difficile* tests lowered significantly postintervention. Therefore, involving all healthcare workers caring for the LTCF residents need to be proactive in AS and infection control.

Policy

This doctoral project can impact the policy making by incorporating an evidence based protocol that would include the nursing staff with emphasis is needed on infection control and antibiotic stewardship (AS) education. The nursing staff should also be part of the data collection and analysis of the effectiveness of the chosen ASP through easy understanding and allocation of healthcare roles. This can develop the healthcare providers' confidence in AS engagement and determine the best and worst practices in preventing antibiotic resistance, thus promoting continuous and improved resident healthcare outcomes (Katz et al., 2017). In addition, this project can help build partnerships within the local, regional, state and federal healthcare organizations in creating a better Antibiotic stewardship program in medical settings such as LTCFs (Arizona Department of Health Services, 2016)

Project Sustainability

Sustainability of the project will depend on the nursing administration and the nursing staff. The results of this project have been presented to the key stakeholders. From there, the nursing leaders can implement the educational sessions to all nursing staff in the LTCF which takes approximately 30 minutes and that includes answering any questions and completing the

pre and posttest. This can be implemented during one of their staff meetings. It would be better if primary care providers, infection control provider, pharmacist and the infection preventionist to be part of the meeting and encourage the nursing staff to be involved. Having a good working relationship can promote effectiveness of the educational training and upgrade to a more comprehensive ASP.

If this project will be sustained to promote AS, there will be an increased adherence to guidelines, program participation, improved health care performance and organizational collaboration. This creates a network of reliable nursing staff who are experts in Sepsis control and AS. Moreover, this generates empowered leaders in promoting a curriculum that prepares the nursing staff for sepsis prevention and unnecessary antibiotic use.

Discussion

Antibiotics are now considered limited due to resistance resulting from the widespread unnecessary antibiotic prescribing mainly in nursing homes. Consequently, interventions like ASPs are proposed to eradicate this life-threatening enigma. The goal of AS is to heighten clinical outcomes while curtailing unintentional effects of antibiotic use such as toxicity, pathogenic microorganisms like *C. difficile* and resistance. Various approaches for effective ASPs are feasible in LTCFs but multidisciplinary consultation is necessary. The inclusion of the healthcare team particularly the nursing staff, the frontline members of patient care, is required to obtain the maximum benefit of the selected method. Interventions like identifying signs and symptoms, following guideline-based treatments, education and infection control have demonstrated to improve antibiotic prescribing behaviors, health outcomes, healthcare utilization, health prevention and increased adherence to recommended treatment guidelines. Therefore, ASPs can enhance provider knowledge and foster resident safety and quality of life.

The results of this project show that nursing staff's personal knowledge rating on infection control and antibiotic stewardship did not improve after implementing the educational training. In addition, education provided did not improve their work relationship. Although the said intervention did not show any statistical significance, it demonstrated clinical significance. Determining a suitable educational training that would be conducive for learning following the LTCF's culture and advocating a multidisciplinary approach with the chosen ASP is necessary to achieve better results.

Findings to What Others Have Found

According to Feldstein and colleagues (2018), there has been a reduction in the amount of antibiotic prescribing in nursing homes and improved guideline adherence after enforcing the use of antibiotic stewardship. In addition, educational interventions on guidelines and feedback to prescribers and staff has proven to lower antibiotic use. The use of prescribing guides, pocket cards, antibiograms, data gathering forms, pre-printed order sets and electronic medical records to facilitate chart review and communication with constant communication with the local stakeholders, facility leaders, infectious disease experts, residents and family members can decrease antibiotic use, *C. difficile* incidences, improved use of guideline-concordant antibiotics and sustained chosen intervention even after the study implementation (Katz et al., 2017). Moreover, a study conducted by Romøren and colleagues (2017) affirms that conducting an educational program to the nursing home staff was practical and effective in decreasing acute hospital admissions for treatment of dehydration and infections. Morrill et al. (2015) and Romøren et al. (2017) indicated that the use of antibiotic stewardship programs can decrease unnecessary healthcare utilization and hospitalizations.

Limitations and Challenges Encountered

This doctoral project has multiple limitations. First, the sample size is small and limited. The project director was only allowed to do the project in the skilled nursing unit. Some of the nursing staff declined to be part of the project due to time constraints and contractual assignments that would hinder them to be part of full duration of the project. Moreover, due to the short intervention period of 12 weeks, this has affected the results of the study. The educational training was conducted based on the availability of the nursing staff despite the attempt to have a large group session of 30 minutes. Since this educational training is based on the availability of the nursing staff, it is unknown if the participants communicated test materials to one another, which may threaten the validity of the study. Furthermore, the variability in participants is one of the limitations. Nurses and CNAs have different educational background, responsibilities and roles in any LTCF. Although the knowledge questionnaire was customized based on their educational background and roles in nursing, some of the CNAs are in nursing school and that might weaken the knowledge questionnaires validity. Lastly, the LTCF's readiness to change may influenced project implementation. Although this was not measured in this doctoral project, the nursing administration had recognized the need for support in AS but may not be fully on board with course of evidence-based change. This may impact the nursing staff's motivation to embrace change.

Recommendations

Patient outcomes were not evaluated in this doctoral project. Future research may emphasize the effect of sepsis education on patient outcomes like financial burden, quality of life, mortality and morbidity. In addition, additional research is needed to identify ways to determine barriers in implementing an ASP in order to be prepared in handling those challenges during implementation. Also, measuring the participants and the nursing administrations'

readiness to change should be done at the beginning of the chosen intervention so that the results could be exposed, and solutions will be implemented. If the participants have the willingness to change along with a great support from the leadership team, any ASP might be successful. According to Morrill and colleagues (2016), further research is needed to expand the collection for Antibiotic stewardship interventions in nursing homes and identify effective strategies. Due to the wide diversities between the acute care hospitals and nursing homes, the capability to attain financial support from leadership for antibiotic stewardship multidisciplinary personnel and other resources may be challenging. Thus, further research on antibiotic stewardship interventions that are efficient but can also promote a cost effectiveness is needed to aid nursing homes cope with their limited resources.

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Appendix A

Table 1

Evaluation table

Citation	Theory/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Major Variables Studied and their Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Results	Level of evidence/ Decision for Use/Application to Practice
Eke-Usim et al. (2016) Constitutional Symptoms Trigger Diagnostic Testing before Antibiotic Prescribing in High-risk Nursing home residents **Country:** USA **Funding:** Veterans Affairs Healthcare System Geriatric Research, Education and Clinical Care Center, National Institute on Aging Pepper	NS - Transitional Care model	**Design:** Longitudinal cohort study derived from a cluster-randomized intervention trial **Purpose:** Evaluate the use and timing of diagnostic testing before initiating an antibiotic regimen in high risk NH residents with indwelling devices suspected of having a	**N= 162** **Demographics:** M age = 72.2 Male = 57% (n=93) Non–Hispanic = 86% (n=118) **Setting:** Southeast Michigan, USA **Timeline:** May 2010- 2013 **Inclusion:** Residents with indwelling device (feeding tubes, Foley urinary catheters or suprapubic catheters) belonging to the parent study's control group **Exclusion:** Residents who only	**IV –** Presenting clinical symptoms for diagnosing UTI and PNA **DV1 –** Diagnostic testing **DV2 –** Antibiotic use	Clinical and demographic data (incident infections, antibiotic use, diagnostic results) gathered during the enrollment, 14 days after and monthly in 1 year.	*t*-test, Pearson chi-square test, assessment of the variation in infection rates and antibiotic use, random-effects Poisson model, Gauss-Hermite quadrature method Strata/MP version 13.1	**DV1:** UA – aOR = 5.3 $P < 0,001$ UC – aOR = 5.3, $P < 0.001$ Sputum Culture – aOR = 17.2, $P < 0.001$ CXr – aOR = 6.5, $P < 0.001$ Blood Culture – aOR = 2.5, $P = 0.01$ **DV2:** 38% (n=131 prescriptions) started antibiotics before diagnostic tests were performed, 62% (n= 213) started after confirmatory test consistent with infection	**Level of Evidence:** Level II **Strengths:** Explored the predictors of diagnostic testing, variations in antibiotic use and the extent wit which different diagnostic tests influence decisions regarding antibiotic prescription. Prospective longitudinal design involving high risk residents from multiple NH. **Weaknesses:** Not generalizable to all NH residents due to sample inclusion, cost analysis not included, **Conclusion:** Clinical symptoms of UTI and PNA lead to prescribing diagnostic

AHRQ - Agency for Healthcare and Research Quality; **AIDS** - Acquired Immunodeficiency Syndrome; **aOR** - Adjusted Odds Ratio; **AS** - Antibiotic Stewardship; **ASP**- Antibiotic Stewardship Program; **BC** - Blood Culture; **CAUTI** - Catheter-associated Urinary Tract Infection; **CDI** - Clostridium difficile infection; **CG** - Control group; **CI** - Confidence interval; **CXr** - Chest X-ray; **DV** - Dependent variable; **EPR** - Estimated prevalence ratio; **FT** - Feeding tube; **IG** - Intervention group; **IV** - Independent variable; **IVN –** Intravenous; **LTCF** - Long term care facility; **M –** Mean; **Md –** Median; **MDRO** - multidrug resistant organism; **MRSA** - Methicillin-Resistant Staphylococcus Aureus; **NH**- Nursing home; **NS** - Not stated; **PNA –** Pneumonia; **PostT** - Posttest; **PreT**- Pretest; **pt. –** patient; **RTI** - Respiratory Tract Infection; **SSTI** - Skin/soft tissue infection; **UA –** Urinalysis; **UC** - Urine Culture; **UK** - United Kingdom; **USA** - United States of America; **UTI** - Urinary Tract Infection; **VA** - Veterans Administration; **VISN** - Veterans Integrated Service Network; **VRE** - Vancomycin Resistant Enterococcus; **WHO** - World Health Organizatio

Center Grant and National Institute on Aging Grants **Bias:** None		UTI, Pneumonia, or both.	had a baseline visit from the parent study control group **Attrition:** none					testing and antibiotics. Antibiotics is still maintained despite negative results. **Feasibility:** The evidence suggests that these approaches should increase efforts to improve antibiotic stewardship, reduce MDROs and enhance NH resident's quality of life.
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Feldstein et al. (2017) Antibiotic stewardship Programs in Nursing Homes: A Systematic Review **Country:** USA **Funding:** None **Bias:** Two studies ensured that their data	NS - Twenty-One Nursing Problems	**Design:** Systematic Review **Purpose:** To assess the possible benefit of ASP in NH and to determine if these ASP lead to better health outcomes and drop rates of health care use.	**N=**14 studies (250 NH total) **n=** 5 cRCT n= 3 controlled before-after trials **n=** 4 before-after trials without controls **n=** 2 nonrandomized control trials **Setting:** USA, UK, Sweden, Canada and Netherlands **Inclusion**: English language RCT, nonrandomized trials and	**IV-** ASP **DV1** - health outcomes **DV2** - rates of health care utilization **DV3 –** intermediate health outcomes	Loeb Minimum criterion, McGeer criteria, NH acquired pneumonia management guidelines, study specific guidelines	Quality synthesis based on characteristics and findings of included studies Quality assessment based on overall quality of evidence (High, moderate, low).	**DV1-** no evidence that NH ASPs change the incidence of CDI, or mortality. **DV2 –** No evidence that NH ASP change the incidence of rates of hospitalizations. No study measured emergency room visits. **DV3 –** NH ASP can reduce the	**Level of Evidence:** Level I **Strengths:** Extracted pertinent data about methods, populations, interventions, comparators, outcomes, timing, settings and study design, Assessed the quality of included studies. **Weaknesses:** Limited # of RCT, 12 studies at risk for selection, performance and detection bias and heterogeneity

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abstractors were blinded to the NH allocation			observational studies of eligible interventions in adults aged 65 and older conducted in countries categorized as "very high" on Human development index. **Exclusion:** studies of pts. with active Cancer, Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome, End stage renal disease needing Hemodialysis, organ transplant recipients, conditions caused or required immunosuppression **Attrition:** N/A				number of antibiotic prescribing and improve the adherence to recommended treatment guidelines.	of study population, intervention and staffing. **Conclusions:** ASP can decrease antibiotic prescriptions. Ideally, it may enhance health outcomes for NH residents but results have not shown decline in emergency room visits, hospitalization, or CDI rates. **Feasibility:** The evidence on the ASP success in NH is encouraging but inadequate. More research is needed to determine ASP will improve NH residents' health and which ASP is effective
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Fleet et al. (2014) Impact of Implementation of a novel antimicrobial stewardship	NS - Transitional Care Model	**Design:** Prospective cRCT **Purpose:** Evaluate a novel AS	**N=** 30 NH/3,238 NH residents PreT n=1628 (825 IG/803 CG) PostT n=1610 (838 IG/772CG)	**IV:** Resident Antimicrobial Management Plan **DV:** Change in systemic antibiotic use for	Clinical and demographic data, Mean point prevalence data	Mixed-effects Poisson regression models, McGeer criteria, Revisited McGeer criteria,	**DV1: IG** PreT and PostT prevalence of 6.46% and 6.52%, EPR: 1.01 (95% CI:	**Level of Evidence:** Level II **Strengths:** First in London that used broad data on the degree of systemic

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tool on antibiotic use in nursing homes: A prospective cluster randomized pilot study **Country:** England **Bias:** None **Funding:** North West London Hospitals NHS trust, Bupa		tool, Resident Antimicrobial Management Plan (RAMP), to promote good practice in antimicrobial use for treatment of infection in NH.	**Demographic:** **M age =** 77 (IG) and >85 (CG) **Male %** = 33.5 (IG) 33.2 (CG) **Setting:** London, England **Inclusion:** Residents receiving 24-hour care provided by qualified nurses employed by the NH. **Exclusion:** NS **Attrition:** NS	treatment of infection **DV1:** Prescribing practices **DV2:** Compliance with RAMP **DV3:** Appropriateness of prescribing antibiotics **DV4:** Prevention of infection		North American consensus criteria, Loeb minimum criteria, Fisher exact test	0.81 – 1.25), *P*=0.94 CG PreT and PostT prevalence of 5.27% and 5.83%, EPR: 1.11 (95% CI: 0.81-1.25), *P*=0.4) **DV2:** 46% of RAMPs were 100% complete for Part A and 40% being >=80% complete. For Part B, 31% of RAMPs were 100% complete and 26% being >=80% complete. **DV3:** McGeer criteria IG: PreT 9.4% PostT 11.1% CG: PreT 7.8% PostT 2.6% Fisher's exact test: PreT *P*=0.08 and PostT *P*=0.004 Revisited McGeer criteria: IG: PostT 10.4%	antibiotics use in NH. Before-and-after intervention study with concurrent controls. **Weaknesses:** Data from RAMP was frequently lacking sufficient clinical detail, deficient data on antibiotic treatment initiated in the hospital following emergency or inpatient stay, no control on effects of local antibiotic prescribing initiatives. **Conclusion:** This demonstrated that the use of RAMP was related with statistically substantial decline in total antibiotic consumption and has the possibility to be a vital AS tool for NH. **Feasibility:** Recommended for use in practice due to the effectiveness of the RAMP as an AS tool for NH.

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							CG: PreT 5.8% PostT 0.9% Loeb Minimum Criteria: In both groups and in both phases, more prescriptions for treatment of SSTI (43/139=31%) fully met the criteria than for UTI (16/143=11%) or Lower RTI (0/183=0%) **DV4:** IG PreT=2.46% PostT=2.18% CG PreT=4.44% PostT=5.10% Total systemic antibiotic use for prophylaxis (in DRD) IG PreT= 8.91 PostT=6.19 CG PreT=12.34 PostT=13.17	

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Citation	Theory/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Major Variables Studied and Their Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Results	Level of evidence/ Decision for Use/Application to Practice
Katz et al. (2017) Implementing Antimicrobial Stewardship in Long-term Care Settings: An Integrative Review Using a Human Factors Approach **Country:** USA **Funding:** AHRQ, NIH, Cleveland Department of Veterans Affairs, VISN 10 Geriatric Research Education and Clinical Center and VA Merit Review Program, Atlantic Philanthropies, Inc, the John A. Hartford Foundation, Association of	Behavior change theory	**Design:** Integrative Literature review **Purpose:** To detect if educational interventions and multimodal interventions would support efficient ASP application strategies	N=20 (197 NHs) n=5 RCT n=15 Quasi-experimental analyses **Setting:** Ontario, Italy, Sweden, USA-- Idaho, Maryland, California, Texas **Inclusion:** Primary research studies in English, describing ASP in LTCF, use quantitative outcome measures **Exclusion:** studies based on ambulatory or acute care facilities, no ASP, disuse of quantitative outcome measures **Attrition:** NS	**IV1:** Educational Interventions **IV2:** Multimodal Interventions **DV:** Effectiveness of ASP implementation strategies **DV1:** Antibiotic use **DV2:** Appropriate indications for diagnostic testing **DV3:** Decrease in morbidity **DV4:** Improved use of guideline-concordant antibiotics	Data evaluation focused on specific infectious syndrome and quantitative outcome measures	Systems Engineering in Patient Safety Analysis Quality assessment based on overall quality of evidence (High, moderate, low).	**DV:** Both educational efforts and work system components are effective and theoretically complimentary approaches to support ASP in LTCF **DV1:** Majority of the studies resulted in a decreased total antibiotic use. **DV2:** Decreased collection of urine cultures by 2-fold after educating staff **DV3:** Decreased incidence of CDI **DV4:** Multimodal approach there is an increased improvement in guideline-	**Level of Evidence:** Level I **Strengths:** Most of the articles are graded good on quality assessment **Weaknesses:** limited number of RCT Six out of 20. Only one intervention focused on local stakeholder involvement and conveyed acceptable outcomes. High risk of bias. **Conclusion:** Effective ASP in LTCF is endorsed by integrating multidisciplinary education, tools assimilated into the workflow of nurses and prescribers that enable review of antibiotic use and participation of infectious disease consultants. **Feasibility:** May be useful in developing

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Specialty Professors, Infectious Society of America, National Foundation for Infectious Disease **Bias:** R.J. (an author) is co-principal investigator on a research grant from Pfizer.							concordant antibiotics	and implementing ASP in LTCF.
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Meddings et al. (2017) Systematic Review of Interventions to Reduce Urinary Tract Infection in Nursing Home Residents **Country:** USA **Bias:** SS (author) received fees	NS - The Health Promotion Model	**Design:** Systematic Literature Review, Narrative review **Purpose:** Review the existing evidence to avoid UTIs in NH residents and acquaint bedside	**N=** 20 records (19 studies) (914 total NH) **n=** 8 RCTs **n**= 10 pre-post non randomized interventions **n**= 1 non-randomized intervention with concurrent controls **Setting:** Australia, China, Italy, Netherlands, USA, Taiwan	**IV1:** Urinary catheter care interventions **IV2:** Infection prevention and antibiotic use strategies. **DV1:** Healthcare-associated UTI **DV2:** CAUTI **DV3:** Bacteriuria	Preferred Reporting Items for Systematic Reviews and Meta-Analysis recommendations for the systematic review and the narrative review was done using articles obtained through systemic search and a targeted literature review, Modified Quality Index Checklist	Quality assessment based on overall quality of evidence	**DV1:** Twelve UTI outcomes, nine studies showed UTI reduction (none significantly) **DV2:** Nine CAUTI outcomes, five studies showed CAUTI reduction (One significantly) **DV3:** Four Bacteriuria	**Level of Evidence:** Level I **Strengths:** Detailed and broad search strategy applied with more inclusion of interventions and outcomes to emphasize the existing evidence and particulars of interventions that have been studied and applied

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for working as an advisor for Doximity and Jvion. **Funding:** AHRQ		care and future research.	**Inclusion:** Randomized controlled trials, non-randomized trials (pre-test/post-test, with or without concurrent or non-concurrent controls), with any duration of post-intervention follow up. Studies written in English language. Studies with interventions and outcomes in NH (skilled nursing and LTCF), rehabilitation facilities and spinal cord injury programs focused on reducing CAUTI risk for chronically catheterized residents **Exclusion:** Observational and retrospective studies, studies done in long term acute care hospitals, hospice, psychiatric/mental health facilities, pediatric and community dwelling/outpatient settings.	**DV4:** Urinary catheter use measures			outcomes, two studies showed bacteriuria reduction (none significantly) **DV4:** Five catheter-use outcomes, four studies showed catheter use reduction (one significantly),	**Weaknesses:** Few studies showed statistically low significance; pooled analyses were not feasible. Many studies provided limited data on outcome and intervention definitions. **Conclusion:** Numerous interventions which are implemented in bundles, appear to decrease UTI or CAUTI in NH residents. **Feasibility:** Recommended to use a comprehensive program to improve antibiotic use, hand hygiene and presumptive precautions with catheters in practice since this has shown a high level of significance in lowering CAUTI.

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			Attrition: NS					
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Mody et al. (2015) A Targeted infection prevention intervention in Nursing home residents with indwelling devices: A Randomized Clinical Trial **Country:** USA **Bias:** None **Funding:** National institute on Aging, National Institutes of Health, Claude D. Pepper Older American Independence Centers funding	NS – The Health Promotion Model	**Design:** Randomized Clinical Trial **Purpose:** To test whether a multimodal target infection program lessens the prevalence of MDROs and incident device related infections	**N=** 12 NH **n=** 203 participants (IG) **n=** 215 participants (CG) **Demographics:** **M age:** 74 (IG); 73 (CG) Male (%): 46.8 (IG); 57.2 (CG) **Setting:** Southeast Michigan, USA **Inclusion:** Study sites are Medicare and Medicaid-certified NH with an infection control program, an onsite infection preventionist and have laboratory and radiology services access. Participant who is a short-stay or long-stay resident with a Foley catheter, FT (nasogastric or percutaneous	**IV:** Targeted Infection Prevention program interventions **DV1:** MDRO rates – each participant's total number of MDRO- positive anatomic site across all MDROs per visit averaged over the duration of his/her participation **DV2:** Incidence rates of device-specific infections – clinical note in the participants medical record documenting an infection and a prescription of a systemic antibiotic for at least 3 days to treat the infection.	Participant characteristics and demographics, Centers for Medicare and Medicaid Services 5- star quality rating system to compare NH's quality measures, staffing and health inspections, Prevalence measures, risk of new MDRO acquisition	Mixed-effects multilevel Poisson regression model, Cox proportional hazards model	**DV1:** NH had a decrease in the overall MDRO prevalence density (rate ratio, 0.77; 95% CI, 0.62-0.94, *P*= 0.01); **DV2:** MRSA acquisitions is lower in the IG (rate ratio, 0.78; 95% CI, 0.64-0.96, *P*= 0.01); Hazard ratio for catheter-associated UTI were 0.54 (95% CI, 0.30-0.97) for the IG and 0.69 (95% CI, 0.49-0.99, *P*= 0.04). No reductions in new VRE or resistant gram-negative bacilli acquisitions or	**Level of Evidence:** Level II **Strengths:** Blinded in processing microbiology cultures, Power analysis done, Assessment of the targeted infection prevention intervention in NH and the aim to cut MDRO colonization and infections in high-risk population with indwelling catheters. This study is one of the studies implicating a community-based NH revealing the horizontal interventions to improve routine infection prevention practices, reduce MDRO colonization and antibiotic use related to CAUTIs in a high-risk population.

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			endoscopic gastrostomy tube), or both for more than 72 hours and signed an informed consent **Exclusion:** Residents receiving end of life care, participants with baseline visits only and no follow up **Attrition:** NS				in new FT-associated PNA or SSTI	**Weaknesses:** results may not be generalizable to other types of LTCFs, to other potentially at-risk NH residents, the use of clinical-based CAUTI definition and the conservative monitoring of hand hygiene. **Conclusion:** The multimodal targeted infection prevention intervention decreased the total MDRO prevalence density, new MRSA acquisitions and clinically defined catheter-associated UTI rates in high-risk NH residents. **Feasibility:** Results identified are recommended for use in practice due to higher SOE with the interventions and its effectiveness.

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Morrill et al. (2015) Antimicrobial Stewardship in Long-term Care Facilities: A Call to Action **Country:** **Funding:** VISN 1 Career Development Award, the Providence VA Medical Center of Innovation in Long Term Services and Supports, the Geriatric Research Education and Clinical Centers in VISN, and from NIH, through the Clinical and Translational Science Collaborative of Cleveland	NS – McGill Model of Nursing	**Design:** Structured review **Purpose:** To identify the need for AS in LTCF, barriers to ASP in LTCFs, and previous studies related to implementation of ASP in LTCF to improve antimicrobial use in this setting.	**N=** 67 articles **n=** 207 NHs **Setting:** USA -- Colorado, Idaho, Illinois, Kansas, Maryland, Buffalo, NY, North Carolina, Cleveland, OH, Houston and San Antonio, TX, Canada -- Ontario, Montreal; Finland; London, England **Inclusion:** keywords included in the structured search: antibiotic stewardship, antimicrobial use, long term care facility and NHs, References in English dated between 1966 and June 2015, full text reviews. **Exclusion**: Studies prior to 1966 non-English, **Attrition:** NS	**IV:** Improve antibiotic use in LTCF **DV1:** Need for AS in LTCF **DV2:** Barriers to AS in LTCF **DV3:** Strategies to improve ASP in LTCF	Structured search using Medline, follow up Internet search and search for reference lists from relevant studies.	Descriptive statistics (simple means, frequencies, & 95% CIs, Odds ratio), general estimate equations (chi-squared test, standard error, & parameter estimates)	**DV1:** 30 (44.8%) articles n=23 (76.7%) observational studies n=5 (16.7%) review articles n=2 (6.7%) professional society guidelines; These articles summed up 3 causes for the need of AS in LTCF **DV2:** 26 (38.3%) articles n=9 (34.6%) review articles n=5 (19.2%) professional society guidelines n= 4 (15.4%) observational studies These articles summed up 5 barriers for AS **DV3:** 15 (22.4%)	**Level of Evidence:** Level I **Strengths:** Large sample size with 67 articles. Thorough discussion of evidence regarding different interventions for AS in LTCFs **Weaknesses:** Narrative structured review which is lower level of evidence than Meta-Analysis. Heterogeneity of studies. Only 14 studies of AS interventions in LTCFs. Hence, weaker quality of evidence, results were mixed, interventions varied greatly. **Conclusion:** Antibiotic resistance is a global public health crisis thus, interventions to improve antibiotic use has been implemented. However,

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from the National Center for Advancing Transitional Services component of the NIH and NIH Roadmap for Medical Research **Bias:** A.R.C and R.L.P.J., (authors) received funding from Pfizer, Inc and one author acted as an advisor for Merck, BARD/Davol, Forest and Pfizer Inc.							n=8 (53.3%) quasi-experimental studies, n=5 (33.3%) RCTs, n=1 (6.7%) pre-versus post-intervention survey n=1 (6.7%) systematic review. n=14 (78.6%) multifaceted educational interventions	effectiveness of ASPs in the LTCFs are largely unknown. It is suggested that multifaceted educational interventions may be effective in increasing appropriate antimicrobial use in LTCFs. **Feasibility:** Applicable to LTCF staff and residents. Feasibility of interventions are difficult to assess due to weak quality of evidence and outcomes varied.
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Pasay et al. (2019) Antimicrobial stewardship in rural nursing homes: Impact of interprofessional education	Health Belief Model	**Design:** Cluster Randomized controlled trial **Purpose:** Measure the effect of an AS	**N=** 42 NH **n** = 638 participants (IG) **n** = 620 participants (CG**)** **Demographics:** M bed = 8-112	**IV1:** Increased AS awareness **IV2:** Best practices for the diagnosis and treatment of UTI and Asymptomatic	UC processed and obtained from AHS Provincial Laboratory Services, Prescriptions selected for data collection used for UTI treatment	2-tailed Fisher exact test, generalized least-squares linear regression; R Studio software	**DV1:** (-2.1 tests per 1,000 RD; 95% CI, -2.5 to -1.7; P<0.001) **DV2: IG** (-0.7 prescriptions per 1,000 RD; 95%	**Level of Evidence:** Level II **Strengths:** Blinded randomization, Power analysis done for primary outcomes, Cluster design which allowed for

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and clinical decision tool implementation on urinary tract infection treatment in a cluster randomized trial **Country:** Canada **Bias:** None **Funding:** None		initiative on the rate of UC testing and antimicrobial prescribing for UTIs between IG and CG sites. Secondary goals comprise appraisal of possible damages of the intervention and detecting characteristics of the population prescribed antibiotics for UTI.	M age= 83 (IG), 834 (CG) Male (%) = 37.5 (IG), 36.56 (CG) **Setting:** Alberta, Canada **Inclusion:** Sites should be located in centers with a population census of <15,000 people, were operated by Alberta Health Services, used Meditech as their primary dispensation database and were able to obtain operational approval **Exclusion:** None **Attrition:** NS	bacteriuria management **IV3:** Pamphlet in layman's terms for family and caregivers **IV4:** Considerations in assessing clinical and behavioral changes in NH residents (DELIRIUMS tool) **DV1:** UCs **DV2:** Prescriptions **DV3:** Secondary outcomes – acute care and ED admissions and mortality **DV4:** Resident characteristics	were retrieved from a Meditech Custom search report, NH resident characteristics retrieved from Meditech's Enterprise medical record		CI, -1.0 to -0.04; *P*<0.001) **DV3:** No difference in hospital admissions (0.00 admissions per 1,000 RD; 95% CI, -0.04 to 0.3; *P*=0.76) and the mortality rate decreased by 0.2 per 1,000 RD in the IG (95% CI, -0.5 to -0.1; *P*=0.002) **DV4:** UTI symptoms were charted on 16% of cases and UC testing happened in 64.5% of cases	randomization and analysis, a yearlong follow up allowed seasonal variances and evaluation of the impact of intervention and its sustainability, cost effective intervention with availability of resources, broad interprofessional engagement, large number and variety of rural sites were included promoting generalizability; First study to measure AS intervention aiming on urine testing and suitable treatment of UTIs in a mass of rural NHs. **Weaknesses:** Contamination of CG from other ASP or staff working at more than 1 site, cluster randomization performed based on number of beds only, no stratification for other variables affecting resident care. **Conclusion:** This multimodal AS

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								intervention in rural nursing homes suggestively reduced the rate of UC testing and antimicrobial prescribing for UTIs with no rise in hospital admissions or mortality **Feasibility:** May be useful in expanding and implementing ASP in LTCFs.
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Romøren et al. (2017) A structured training program for health workers in intravenous treatment with fluids and antibiotics in nursing homes: A modified stepped-wedge cluster-randomised trial to reduce hospital admissions	NS - Behavior change theory	**Design:** Modified cluster randomized stepped-wedge trial **Purpose:** Evaluate if a brief training program in administrating intravenous fluids and antibiotics in NHs could lessen	**N=** 30 NHs **n**= 228 participants (IG) **n**=102 participants (CG) **Demographics:** M age = 84 (IG); 84 (CG) Male % = 43 (IG); 41 (CG) **Setting:** Vestfold County, Norway **Inclusion:** A case was defined as a pt. provided IVN treatment (IVN antibiotics or IVN	**IV:** One-day educational program for the health workers (theory and practical training in IVN treatment of dehydration and infection **DV1:** Location of IVN treatment **DV2:** Course of disease and antibiotic use	Consort 2010 Checklist, Patient demographic and clinical data, telephone follow-up, email and telephone support, follow up visits	Independent samples *t*-test (two-sided), two-sided Chi-square test IBM SPSS statistics program and STATA 12, Logistic regression analyses	**DV1:** PreT: Md=0.47 pts treated per 100 beds per month range= 0-4.6 PostT: Md=0.62 pts treater per 100 beds per month range=0-2.8 Proportion treated in the NH CG=37% (28-47% IG=81% (76-86%) (P<0.05)	**Level of Evidence:** Level II **Strengths:** Power analysis was done, the study is a stepped wedge cluster randomized design, efficient implementation of intervention without unexpected challenges, follow up visits were done allowing the researchers to evaluate prognosis, original power calculation was not incorporated in the sample estimate, this

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Country: Norway **Bias:** None **Funding:** South-Eastern Norway Regional Health Authority and the University of Oslo, Norway		hospital transfers and ensure high quality care	fluids) in either the NH or hospital. Pts. admitted to the hospital even if they could have been diagnosed and treated at the NH **Exclusion:** Pts. with septicemia and in need of hospitalization for additional diagnostics or treatment **Attrition:** NS				Treated with IVN fluids from 53% (35-71%) to 92%)87-97%), *P*<0.001 Treated with IV antibiotics 29% (18-41%) to 71% (63-79%), *P*<0.001. **DV2:** PreT M=7.3 days in the hospital M=7.3 days on IVN antibiotics M=3.8 days on IVN fluids PostT M=7.1 days in the hospital (*P*=0.9) M=8.2 days for IVN antibiotics (*P*=0.30) M=4.4 days on IVN fluids (*P*=0.43) Pts treated with IVN antibiotics 50 (46%) died within 30 days in the NH, 30 (36%) treated in	study is the first to assess the result of a training program in IVN treatment in NHs using a stepped-wedge design **Weaknesses:** Difficulties in data collection, two pilot NHs had no observational time and had data for one level only **Conclusion:** A brief educational program delivered to NH staff can effectively reduce acute hospital admissions for treatment of dehydration and infections. **Feasibility:** Recommended since the intervention is vastly efficient in lessening the number of hospital admissions for dehydration and infections among NH residents. Therefore, it may be useful in expanding and implementing ASP in LTCFs.

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							the hospital (*P*=0.19). Pts treated with IVN fluids in the NH, 21 (19%) died within 30 days, 2 (7%) in the hospital (*P*=0.34)	
Citation	**Theory/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Major Variables Studied and their Definitions**	**Measurement/ Instrumentation**	**Data Analysis**	**Findings/ Results**	**Level of evidence/ Decision for Use/Application to Practice**
Van Buul et al. (2015) Effect of tailored antibiotic stewardship programmes on the appropriateness of antibiotic prescribing in nursing homes **Country:** USA, Netherlands Bias: None **Funding:** Netherlands Organization for Health	NS -Theory of Planned Behavior	**Design:** Mixed methods, Quasi-experimental, unblinded study **Purpose:** To evaluate the impact of tailored interventions on the suitability of decisions to prescribe or withhold antibiotics, antibiotic use and guideline-adherent	**N=** 10 NH **IG=** 5 NH/ 328 participants **CG=** 5 NH/ 379 participants **Demographics:** **M age:** 83 (IG); 84 (CG) **Male %:** 29.3 (IG); 26.4 (CG) **Inclusion:** NH in Central west region of the Netherlands **Exclusion:** NH that participated in other infectious disease projects Attrition = NS	IV follows PAR approach **IV1:** ASP selected using the PAR approach **DV1:** appropriateness of decisions to prescribe or withhold antibiotics **DV2:** Antibiotic use and guideline-adherent antibiotic selection **DV3:** Process evaluation	Form based on relevant guidelines and literature, documentation of pt. characteristics, vital signs, current health status, medical history, signs and symptoms related to suspected infection type and details on the prescription, or no antibiotic prescribing including the reason for not prescribing, Overview of all antibacterial for systemic use in	x^2 tests, t-tests and Mann-Whitney *U*-test, Second -order Penalized quasi-likelihood estimation procedure estimation procedure, Markov Chain Monte Carlo method, WHO ATC/DDD Index 2014, Mean	**DV1:** The appropriateness of 1059 (84%) prescribing decisions (IG: PreT-278, PostT-233; CG: PreT-320, PostT-228). 59% were UTIs, 34% RTIs, 7% SIs, Abx prescribed PreT: 88% (IG-91%, CG-86) PostT: (IG-92%, CG-90%) **DV2:** No PreT – PostT difference observed in a subgroup analysis for UTI and RTI (crude:	**Level of Evidence:** Level III **Strengths:** Before-and-after intervention study with concurrent controls; first to evaluate the result of an intervention on this outcome measure in NH. Included infections that were not treated with antibiotics in the evaluation of the suitability of prescribing decisions. **Weaknesses:** Unblinded study, issues with screening facilities, reach of program, and event capture, time-

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Research and Development		antibiotic selection in NH			NH from January 1 to September 30 in 2012 and 2013		*P*=0.26; adjusted for covariates: *P*=0.35). **DV3:** Local stakeholders states that a "ceiling-effect", lack of motivation and physician turnover are the causes of absence of intervention effect.	consuming interventions and limited project budget may have resulted in suboptimal application of PAR approach **Conclusion:** The PAR approach was ineffective in improving antibiotic prescribing behavior. **Feasibility:** The PAR approach may limit feasibility in ASP due to timewasting interventions. In addition, the study sample is from the Netherlands which limits applicability.

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Appendix B

Table 2

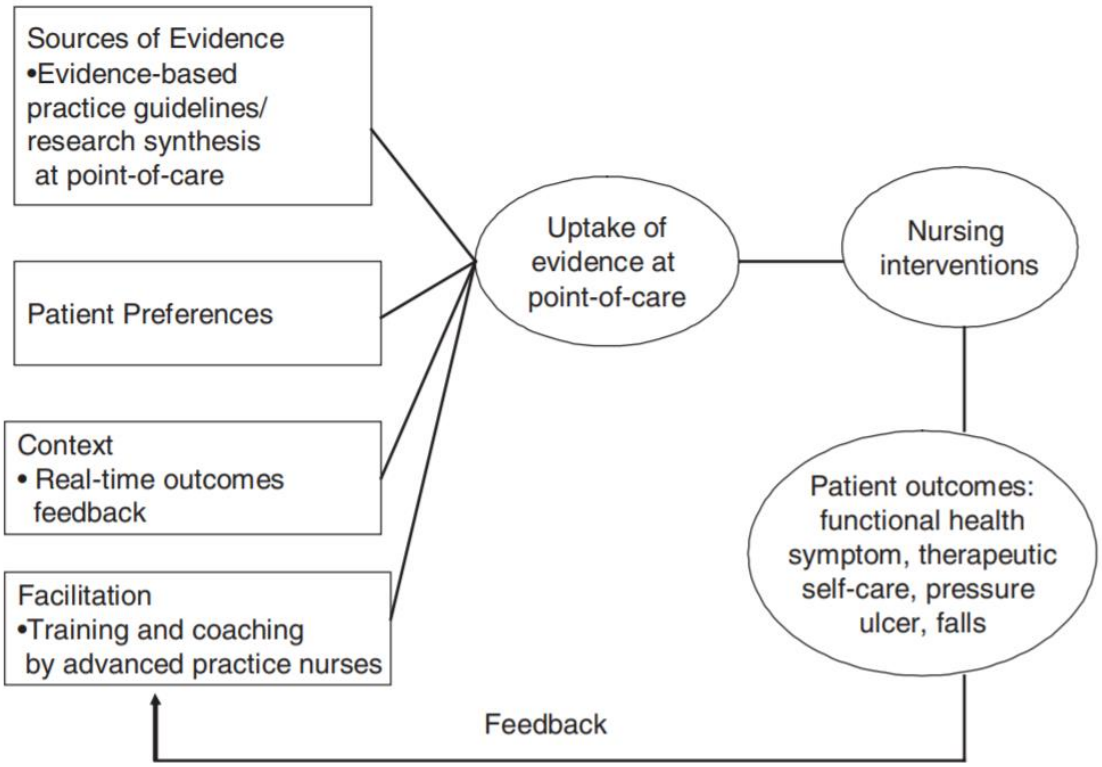
Synthesis Table

	Authors & Year	Eke-Usim et al. (2016)	Feldstein et al. (2017)	Fleet et al. (2014)	Katz et al. (2017)	Meddings et al. (2017)	Mody et al. (2015)	Morrill et al. (2015)	Pasay et al. (2019)	Romøren et al. (2017)	Van Buul et al. (2015)
Study characteristics	Design	LC	LR	cRCT	LR	LR	RCT	LR	cRCT	cRCT	MM, QE
	LOE	II	I	II	I	I	II	I	II	II	III
	Mean age IG/CG	72		77/ >85			74/73		83/84	84/84	83/84
	# of NH	12	205	30	197	914	12	207	33	30	10
	# of participants (IG/CG)	162		3,238			203/ 215		638/ 620	228/ 102	328/ 379
	Male (%) (IG/CG)	57		33.5/ 33.2			46.8/ 57.2		37.5/ 36.5	43/31	29.3/ 26.4
	Bias	0	Low	0	Low	Low	0	0	0	0	0
	Setting	US	CA, S, N, US, UK	UK	CA, IT, S, US	AU, N, CH, IT, T, US	US	CA, F UK, US	CA	NO	N, US
Interventions	Identify S/Sx	x	x	x	x				x		x
	Guidelines		x	x	x	x	x	x	x		x
	Education		x		x	x	x	x	x	x	x
	Infection Prevention		x		x	x	x				
	Multidisciplinary Consult		x	x	x	x	x	x	x		x
Outcomes	Prescribing Diagnostic tests	↑			↓			↓	↓		
	Antibiotic prescription	↑	↓	↓	↓	↓		↓	↓		NSS
	Health outcomes		NSS		↓	↓	↓	↓	↓	↓	
	Health care utilization		NSS			↓		↓	NSS	↓	
	Prevention		↑			↑		↑			
	Adherence to guidelines		↑		↑	↑		↑			NSS

↑ - Increased; ↓ - Reduced; **AU** – Australia; **CDI** - Clostridium difficile; **CA** – Canada; **CH** – China; **cRCT**- Clustered randomized controlled trial; **F** – Finland; **IT** – Italy; **LOE** – Level of evidence; **LC** - Longitudinal Cohort; **LR** - Literature Review; **MM** - Mixed Methods; **N** – Netherlands; **NH** – Nursing homes; **NO** – Norway; **NS** - Not stated; **NSS** - No statistical significance; **QE** - Quasi – experimental; **RCT** - Randomized Controlled trials; **S** – Sweden; **S/Sx** - Signs and Symptoms; **T** – Taiwan; **UK** - United Kingdom; **US** - United States

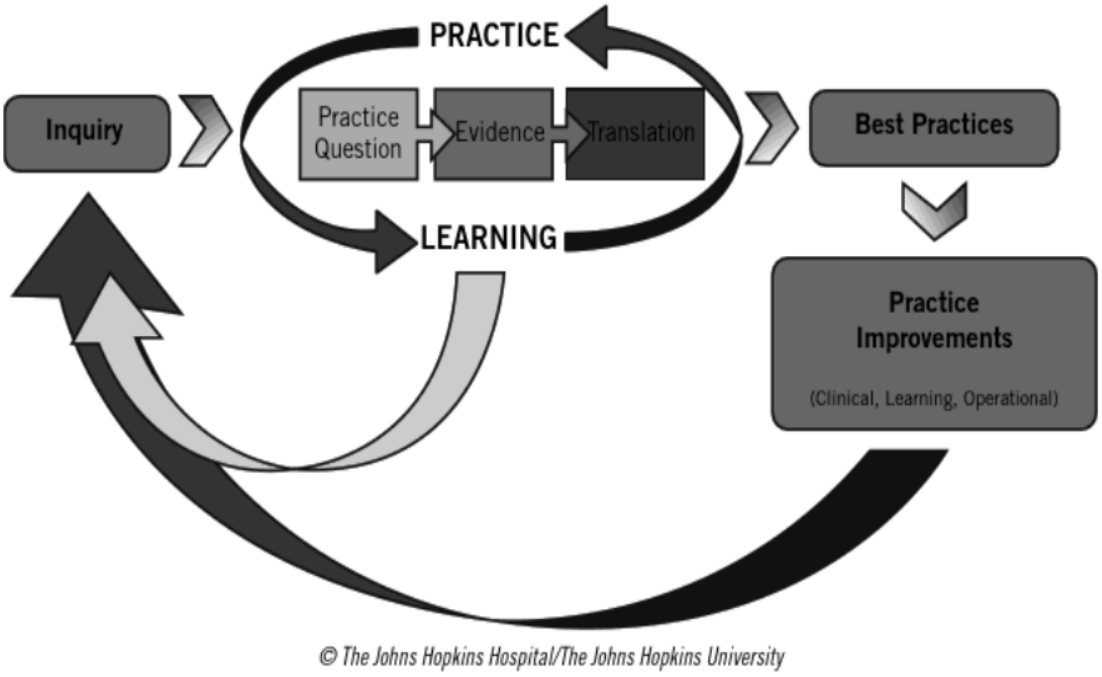
Appendix C

Outcomes-Focused Knowledge Translation Intervention Framework



Appendix D

Johns Hopkins Nursing Evidence-based Practice Model



Appendix E

The Johns Hopkins Evidence Based Practice Process

PET (Practice Question-Evidence-Translation)

PRACTICE QUESTION

Step 1: Recruit interprofessional team.
Step 2: Define the problem.
Step 3: Develop and refine the EBP question.
Step 4: Identify stakeholders.
Step 5: Determine responsibility for project leadership.
Step 6: Schedule team meetings.

EVIDENCE

Step 7: Conduct internal and external search for evidence.
Step 8: Appraise the level and quality of each piece of evidence.
Step 9: Summarize the individual evidence.
Step 10: Synthesize overall strength and quality of evidence.
Step 11: Develop recommendations for change based on evidence synthesis.

- Strong, compelling evidence, consistent results.
- Good evidence, consistent results.
- Good evidence, conflicting results.
- Insufficient or absent evidence.

TRANSLATION

Step 12: Determine fit, feasibility, and appropriateness of recommendation(s) for translation path.
Step 13: Create action plan.
Step 14: Secure support and resources to implement action plan.
Step 15: Implement action plan.
Step 16: Evaluate outcomes.
Step 17: Report outcomes to stakeholders.
Step 18: Identify next steps.
Step 19: Disseminate findings.

Appendix F

Letter of Support from the Director of Nursing

MONTECITO
Post Acute Care and Rehabilitation

July 15, 2019

Arizona State University Human Subjects Institutional Review Board
Office of Research Integrity and Assurance
ASU Centerpoint, Suite 312
660 South Mill Ave
Tempe, AZ 85281-6111

To whom it may concern:

I am writing on behalf of Montecito Post Acute Care and Rehabilitation, to express support for the quality improvement project titled "Infection Control Driven Antibiotic Stewardship in a Long Term Care Facility" as proposed by Diane E. Nuñez DNP, RN, ANP-BC, FNAP and Carla Marie A. Velasquez, BSN, RN, DNP student.

Our organization agrees to serve as the quality improvement project site for data collection, education, use of an improved sepsis algorithm, and data analysis. I understand that this project will be carried out following sound ethical principles and foster confidentiality of data obtained throughout the course of implementation.

Thank you for giving Montecito Post Acute Care and Rehabilitation the opportunity to be part of this essential project.

Sincerely,

Marjorie Barsana, BSN, RN
Director of Nursing
Montecito Post Acute Care and Rehabilitation

Appendix G

Invitational Flyer

Oct. 7, 8, 13 & 15 2019

HOW CLEAN ARE YOU?

KNOCK OUT ~~GERMS &~~ ~~ANTIBIOTIC RESISTANCE~~

A Doctor of Nursing Practice Project

Be part of this learning experience to help save your life as well as your residents from this global threat. Be an advocate for Infection Control, Sepsis and Antibiotic Stewardship.

Speaker: Carla Velasquez, RN, BSN, DNP- Adult Gerontology student

ASU Edson College of Nursing and Health Innovation

Learn about Sepsis

See germs glow on your hands

Master the art of infection prevention

Pledge support against Antibiotic Resistance

Don't Be Shy—Tell Them Why They Can't Miss This Event!

Montecito Post Acute Care and Rehabilitation
Papago Unit

Times:
9 AM – 1 PM
8 PM – 12 AM

Appendix H

Cover Letter and Consent

Cover letter and consent

Infection Control Driven Antibiotic Stewardship in a Long-term Care facility

Dear Participant,

I am a graduate student under the direction of Professor Dr. Diane Nunez DNP, RN, ANP-BC, FNAP in the College of Nursing and Health Innovation at Arizona State University. I am conducting an evidence-based program using an algorithm to manage infections in the long-term care setting. The project will examine nursing staff knowledge of antibiotic stewardship, use of the algorithm, resident healthcare outcomes, and antibiotic use.

This project includes education on infection control, antibiotic stewardship, and how algorithms can be used in the presence of infections to guide care. As part of the project, demographic information and a brief questionnaire will be collected at the start of the project and the questionnaire will be completed again at the end of the project period. The total time required to complete the demographic information and questionnaire before the educational session will be approximately 15 minutes. This will be a tailored individualized educational session and will be a total of 30 minutes. This means that I will provide the education session based on your availability. There will be additional time allowed to answer any questions you may have concerning the project or questionnaires. At the end of the project, the same instrument will be administered as a post-intervention questionnaire and will take approximately 15 minutes to complete.

Your participation in the questionnaires and educational session is completely voluntary. You can skip questions on the questionnaire if you wish. If you choose not to participate or to withdraw from the program at any time, there will be no penalty. It will not affect your employment with the agency prior to, during, or after your participation in the program. There is no known risk greater than those associated with everyday types of activity.

Your responses on the questionnaires will be anonymous and the pre and post-questionnaire responses will be linked using a 4-digit unique, numeric identifier that you select. We will not collect your name or other personal identifying information. The results of this project may be used in reports, presentations, or publications as aggregate data only. Attending the antibiotic stewardship educational session and completing the demographics form and associated questionnaire will be considered your consent to participate.

If you have any questions concerning this program, please contact the following team members:

Carla Marie A. Velasquez, BSN, RN, DNP student at 480-651-7557
Dr. Diane Nuñez, DNP, RN, ANP-BC, FNAP at 602-496-0751

This project has been reviewed and approved by the Arizona State University Institutional Review Board. If you have any questions about your rights as a subject/participant in this project, or if you feel you have been placed at risk, you can contact the Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Sincerely,

Carla Marie A. Velasquez, BSN, RN
Doctor of Nursing Practice, Adult-Gerontology Student
Arizona State University

Appendix I

Demographic Questionnaire

Demographic Questionnaire

Project ID = last 2 digits of your phone number + last 2 digits of your birth year + 2 digits of your birthday. Use leading zero if birthday is 1-9

Project ID number: _____ Date: _____

Infection Control driven Antibiotic Stewardship Program in a Long-term Care Facility

Demographic Questionnaire

Please check the box that best corresponds to your answer or provide a response for each question below

- **Age:** _____

- **Gender:** ☐ Male ☐ Female ☐Other: Please specify: _____

- **Race/Ethnicity:**

☐ 1. African American
☐ 2. Asian
☐ 3. Caucasian
☐ 4. Hispanic or Latino
☐ 5. Native American
☐ 6. Pacific Islander
☐ 7. Other: Please specify: _____

- **Marital Status:**

☐ 1. Single
☐ 2. Married
☐ 3. Widowed
☐ 4. Divorced
☐ 5. Separated
☐ 6. Living with partner

- **Highest Level of education:**

☐ 1. Less than High School graduate
☐ 2. High school graduate or GED
☐ 3. Some College, Associates degree
☐ 4. Bachelor's degree
☐ 5. Master's degree
☐ 6. Doctoral degree
☐ 7. Other: Please specify: _____

- **Current employment:**

☐ 1. RN
☐ 2. LPN
☐ 3. CNA

☐ 1. Full time (35 hours or more per week)
☐ 2. Part-time (less than 35 hours per week)

- **Work shift:** ☐ Days (0700 – 1930) ☐ Nights (1900 – 0730)

- **Years of experience on current profession:**

☐ 1. Less than 1 year
☐ 2. 1 year – 3 years
☐ 3. 3 years - 5 years
☐ 4. 6 years – 10 years
☐ 5. 10 years – 20 years
☐ 6. Greater than 20 years

- Does your facility provide educational resources and materials about antibiotic resistance?

☐ Yes ☐ No

- Does your facility provide opportunities to improve antibiotic use? ☐ Yes ☐ No

---

- Can you rate your knowledge on Infection Control and Antibiotic Stewardship?

1	2	3	4	5	6	7	8	9	10
Beginner				**Intermediate**					**Expert**

Appendix J

Work Relationship Scale

Questions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly disagree
1. This unit encourages nursing staff (i.e., RN, LVN, MA, CMA) input for making changes.					
2. Most people in this unit are willing to change how they do things in response to feedback from others.					
3. Most people in this unit actively seek new ways to improve how we do things.					
4. Most people in this unit are comfortable voicing their opinion even though it may be unpopular.					
5. Most people in this unit pay attention to how their actions affect others in the unit.					
6. After making a change, we usually discuss what worked and what didn't.					
7. Most people in this unit get together to talk about their work.					
8. This unit values people who have different points of view.					
9. Difficult problems in this unit are usually solved through face-to-face discussion.					
10. We regularly take time to consider ways to improve how we do things.					
11. When there is a conflict in this unit, the people involved are encouraged to talk about it.					
12. Most people in this unit understand how their job fits into the rest of the clinic.					
13. This unit usually encourages everybody's input for making changes.					
14. My opinion is valued by others in this unit.					
15. The leadership in this unit usually makes sure that we have the time and space necessary to discuss changes to improve care.					

Appendix K

Knowledge Questionnaire for Nurses

Project ID number: _____ **Date**: _____
(Last 2 digits of your phone number + Last 2 digits of your birth year + 2 digits of your birthday. Use leading zero if birthday is from 1-9).

Infection control driven Antibiotic stewardship Program in a Long-term Care Facility

Sepsis and Infection control Knowledge Questionnaire for Nurses

Please read the questions carefully. Encircle T if the statement is true and F if the statement is false.

True	False	QUESTION
T	F	1. Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection
T	F	2. Systemic inflammatory response syndrome (SIRS) is a subset of sepsis with circulatory and cellular or metabolic dysfunction associated with higher risk of mortality
T	F	3. Only Nurses and Clinicians participate in Sepsis alerts.
T	F	4. If resident has **NO** suspected infection and 2 or more SIRS criteria, resident is negative for sepsis.
T	F	5. Diabetes, cancer and extremes of age are **NOT** risk factors for Septic shock.
T	F	6. To practice antibiotic stewardship, frequent hand washing and getting recommended vaccinations is necessary in caring for residents with an antibiotic-resistant infections who can be susceptible to sepsis.
T	F	7. Injuries like infected bug bites or scratches could **NOT** cause Sepsis.

T	F	8. A healthcare provider does **NOT** need to change gloves after touching blood or body fluids if caring for the same patient.
T	F	9. Sequence for putting on personal protective equipment: Mask, gown, gloves, goggles.
T	F	10. Ensuring consistent environmental cleaning and disinfection like washing hands with soap and water, cleaning resident wheelchairs and no sharing of equipment for residents with *Clostridioides difficile* infection, implemented by the nursing staff, is recommended to prevent spread of infection.
T	F	11. The following are the minimum laboratory workup needed as soon as Code Green/Sepsis alert is activated: Complete blood count with Differential, lactate level (if possible), urinalysis with culture and sensitivity, blood cultures if able; from 2 sites, not from central lines.
T	F	12. If the resident has a Temperature=101.5 F, Pulse rate=130, BP=90/52 mmHg, RR 25 and SpO2 90 with no signs of infection, the resident automatically gets an order from the clinician for antibiotics.
T	F	13. If the clinician decided to transfer resident to a higher level of care/hospital, the nurse should notify the Nurse Manager, prepare the transfer sheet, call ambulance, call report to hospital and report positive sepsis screen.
T	F	14. Multisystem Organ Dysfunction Syndrome occurs when symptoms progress despite treatment, urine output <400ml in 24 hours, SBP <90 despite IV fluids, altered mental status.

T	F	15. Volume replacement is crucial in the initial management of shock and it is recommended to administer Normal saline 0.9% IV @ 30ml/kg if BP <100.

Appendix L

Knowledge Questionnaire for Certified Nursing Assistants

Project ID number: _____ **Date**: _____
(Last 2 digits of your phone number + Last 2 digits of your birth year + 2 digits of your birthday. Use leading zero if birthday is from 1-9).

Infection control driven Antibiotic stewardship Program in a Long-term Care Facility

Sepsis and Infection control Knowledge Questionnaire for Certified nursing assistants

Please read the questions carefully. Encircle T if the statement is true and F if the statement is false.

True	False	QUESTION
T	F	1. Sepsis is a life-threatening organ dysfunction caused by a poorly regulated host response to infection
T	F	2. Systemic inflammatory response syndrome (SIRS) is a subset of sepsis with circulatory and cellular or metabolic failure associated with higher risk of death.
T	F	3. Only Nurses and Clinicians participate in Sepsis alerts.
T	F	4. If resident has **NO** suspected infection and 2 or more SIRS criteria, resident is negative for sepsis.
T	F	5. Diabetes, cancer and extremes of age are **NOT** risk factors for Septic shock.
T	F	6. Residents with a “superbug” or antibiotic-resistant infection are at risk for having sepsis or septic shock, as a good and reliable certified nursing assistant who practices antibiotic stewardship, I can help by

		practicing infection prevention by thorough and frequent hand washing and getting recommended vaccinations.
T	F	7. Injuries like infected bug bites or scratches could **NOT** cause Sepsis.
T	F	8. A healthcare provider does **NOT** need to change gloves after touching blood or body fluids if caring for the same patient.
T	F	9. Sequence for putting on personal protective equipment: Mask, gown, gloves, goggles.
T	F	10. Ensuring consistent environmental cleaning and disinfection like washing hands with soap and water, cleaning resident wheelchairs and no sharing of equipment for residents with *Clostridioides difficile* infection, implemented by the nursing staff, is recommended to prevent spread of infection.

Appendix M

Sepsis Protocol

Sepsis Protocol

Overview:

1. Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection (Papadakis & McPhee, 2016). It occurs when an infection in your skin, lungs, urinary tract, etc. causes a chain reaction throughout your body. Consequently, sepsis can rapidly lead to tissue damage, organ failure, and death if treatment is delayed (Centers for Disease Control and Prevention (CDC), 2018).
2. Septic Shock is a subset of sepsis with circulatory and cellular or metabolic dysfunction associated with higher risk of mortality (Society of Critical Care Medicine, 2016). Risk factors include Bacteremia, extreme ages (<1 year old and >65 years old), diabetes, cancer, lung disease, kidney disease, immunosuppression and history of recent invasive procedure (Papadakis & McPhee, 2016; CDC, 2018).
3. Systemic inflammatory response syndrome (SIRS) is a systemic response to a nonspecific infectious or non-infectious insult (Papadakis & McPhee, 2016).
4. Multisystem Organ Dysfunction Syndrome is the progression of symptoms despite treatment, urine output <400ml in 24 hours, SBP <90 despite IV fluids, altered mental status, the clinician may consider transferring to another level of care - hospital, palliative, or hospice (Minnesota Hospital Association, 2019).

Population: All employees and residents of Montecito Post Acute Care and Rehabilitation

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Purpose: The purpose of this protocol is to provide guidelines for the rational and safe implementation of early detection of suspected infection and management of sepsis.

Components:

1. For Certified nursing assistants and Nurses:
    a. Provide hydration if permitted and promote infection prevention interventions like hand hygiene, provide good oral hygiene and showers daily and as needed, clean wheelchairs etc.
    b. Notify the nurse/Charge nurse if you have identified any change while caring for a resident, particularly:

Suspected infection	**and 2 or more SIRS criteria (100-100-100)**
C – ough	Temperature >100 ˚F or ≤96.8 ˚C
H – ot	Pulse ≥100
A – ntibiotics	Blood pressure <100 or >40 mmHg
D – rainage	Respiratory rate >20/SpO2 <90%
WEAK	Altered mental status (Conscious/confused)

    c. In addition, identify if patient has a suspected infection:
        i. Urinary Tract = frequency, urgency, burning on urination, or pain
        ii. Respiratory = cough, shortness of breath, increase in sputum
        iii. Skin = draining wound, redness, swelling, and warm to touch
        iv. Neurologic = confusion, headache, stiff neck and sensitivity to light

d. If resident has no suspected infection and 2 or more SIRS criteria, resident is negative for sepsis. However, if patient exhibited these symptoms, activate Sepsis Alert or Code Green, identify and review Advance Directive wishes, use the Sepsis SBAR tool and notify the clinician. Notify the family. Inform Nurse Manager as well.
e. If clinician decided to order for transferring resident to a higher level of care/hospital, prepare SBAR sheet, call ambulance, call report to hospital and report positive sepsis screen.
f. If clinician decided for resident to stay in the facility and if Advance Directives and/or resident's wishes are in agreement, consider some or all of following order options within 3 hours:
    i. Laboratory tests (Please note that clinician may add more laboratory orders): Complete blood count with Differential, Basic Metabolic Panel, lactate level (if possible), urinalysis with culture and sensitivity, blood cultures if able; from 2 sites, not from lines. Send all labs as soon as possible.
    ii. Establish IV access for the following:
        1. May start with 500 ml of Normal Saline bolus and clarify with clinician if wanted to add more. (Recommended: IV normal saline 0.9% normal saline/sodium chloride @ 30ml/kg if BP <100)
        2. Administer IV, IM or PO antibiotics per clinician's orders
g. Comfort care on ALL residents experiencing any of the above symptoms: Pain control, Antipyretic for fever, reposition every 2-3 hours, Oral care every 2 hours,

offer fluids every 2 hours as tolerated, keep family informed and adjust care plan as needed.

h. Monitor for progression into Multisystem Organ Dysfunction Syndrome like progression of symptoms despite treatment, urine output <400ml in 24 hours, SBP <90 despite IV fluids, altered mental status and may consider transferring to another level of care - hospital, palliative, or hospice.

i. Monitor Vital signs every 2 hours on the first 8 hours, then every 4 hours for the next 48 hours.

j. Obtain orders to remove any open lines: Foley catheters, central lines and PICC lines for possible source of infection after cultures has been done.

k. Notify clinician as soon as the culture results are back to treat resident with antibiotics appropriately.

References for the updated sepsis protocol

Centers for Disease Control and Prevention. (2018). What is sepsis? Retrieved from https://www.cdc.gov/sepsis/what-is-sepsis.html

Minnesota Hospital Association. (2019). *Skilled nursing facility sepsis algorithm for adults.* Retrieved from https://www.mnhospitals.org/quality-patient-safety/quality-patient-safety-improvement-topics/sepsis#/videos/list

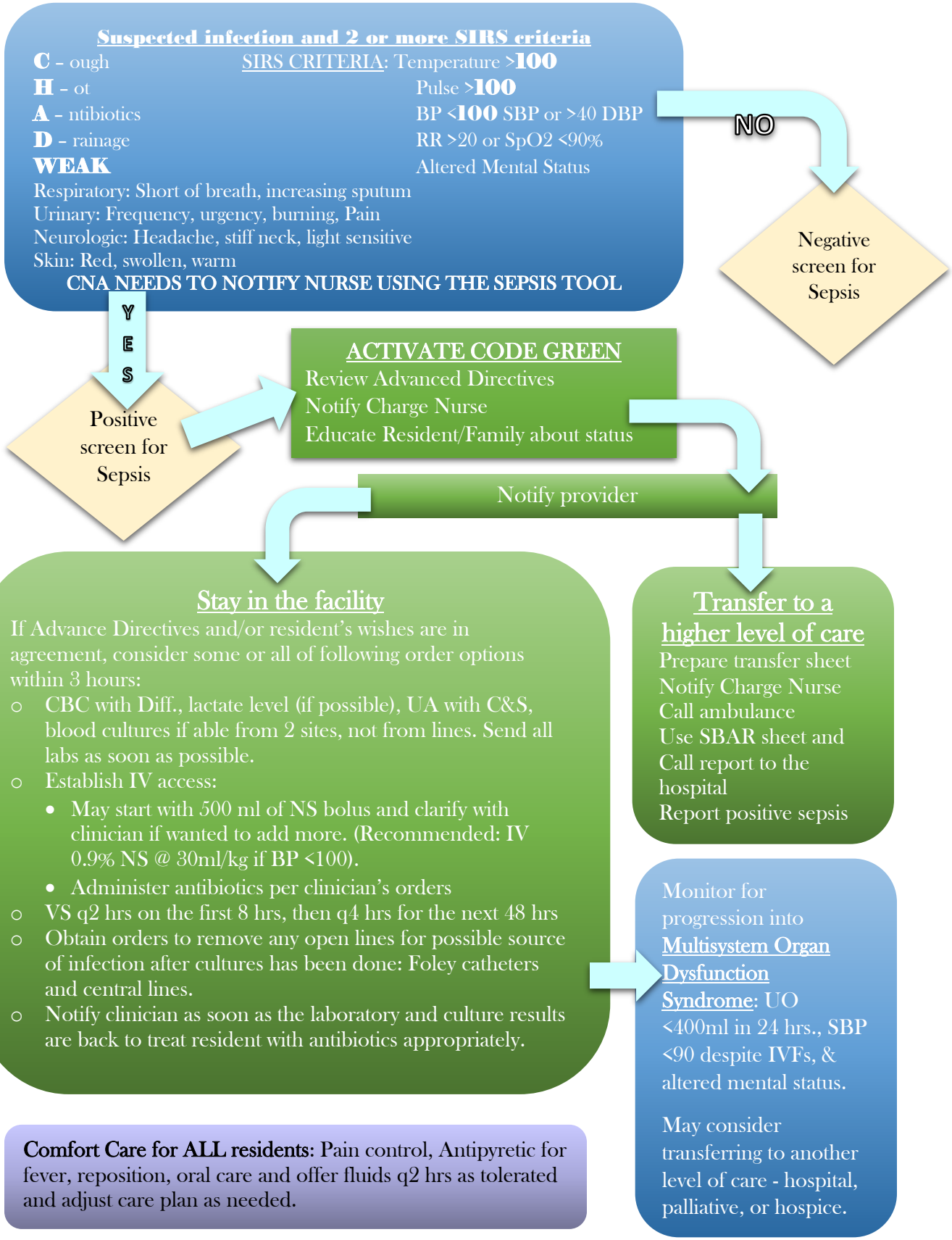
Papadakis, M. A. & McPhee, S. J. (2018). Current medical diagnosis & treatment, fifty-seventh edition. New York: McGraw Hill Education.

Society of Critical Care Medicine. (2016). *Surviving sepsis campaign: International guidelines for management of sepsis and septic shock: 2016*. Retrieved from http://www.survivingsepsis.org/Guidelines/Pages/default.aspx

TMF Health Quality Institute. (2017). *SBAR for Sepsis*. Retrieved from https://www.tmf.org/Portals/0/Documents/CMP/CMP%20Sepsis%20SBAR_508.pdf

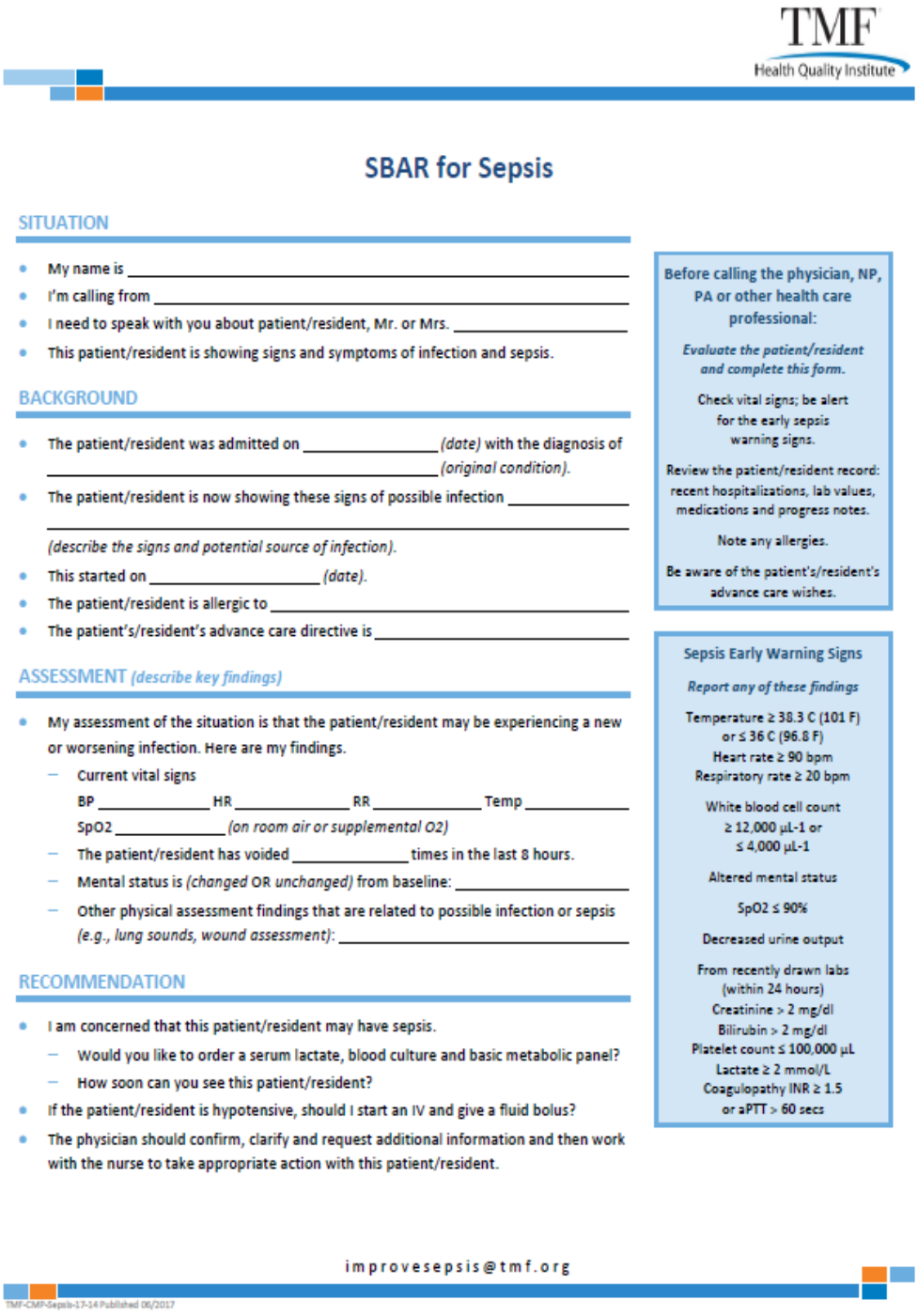
Appendix N

Sepsis Algorithm



Appendix O

SBAR tool for Nurses



TMF Health Quality Institute

SBAR for Sepsis

SITUATION

- My name is _____
- I'm calling from _____
- I need to speak with you about patient/resident, Mr. or Mrs. _____
- This patient/resident is showing signs and symptoms of infection and sepsis.

BACKGROUND

- The patient/resident was admitted on _____ *(date)* with the diagnosis of _____ *(original condition)*.
- The patient/resident is now showing these signs of possible infection _____ _____ *(describe the signs and potential source of infection)*.
- This started on _____ *(date)*.
- The patient/resident is allergic to _____
- The patient's/resident's advance care directive is _____

ASSESSMENT *(describe key findings)*

- My assessment of the situation is that the patient/resident may be experiencing a new or worsening infection. Here are my findings.
  - Current vital signs
    BP _____ HR _____ RR _____ Temp _____
    SpO2 _____ *(on room air or supplemental O2)*
  - The patient/resident has voided _____ times in the last 8 hours.
  - Mental status is *(changed* OR *unchanged)* from baseline: _____
  - Other physical assessment findings that are related to possible infection or sepsis *(e.g., lung sounds, wound assessment)*: _____

RECOMMENDATION

- I am concerned that this patient/resident may have sepsis.
  - Would you like to order a serum lactate, blood culture and basic metabolic panel?
  - How soon can you see this patient/resident?
- If the patient/resident is hypotensive, should I start an IV and give a fluid bolus?
- The physician should confirm, clarify and request additional information and then work with the nurse to take appropriate action with this patient/resident.

Before calling the physician, NP, PA or other health care professional:

Evaluate the patient/resident and complete this form.

Check vital signs; be alert for the early sepsis warning signs.

Review the patient/resident record: recent hospitalizations, lab values, medications and progress notes.

Note any allergies.

Be aware of the patient's/resident's advance care wishes.

Sepsis Early Warning Signs

Report any of these findings

Temperature ≥ 38.3 C (101 F)
or ≤ 36 C (96.8 F)
Heart rate ≥ 90 bpm
Respiratory rate ≥ 20 bpm

White blood cell count
≥ 12,000 µL-1 or
≤ 4,000 µL-1

Altered mental status

SpO2 ≤ 90%

Decreased urine output

From recently drawn labs (within 24 hours)
Creatinine > 2 mg/dl
Bilirubin > 2 mg/dl
Platelet count ≤ 100,000 µL
Lactate ≥ 2 mmol/L
Coagulopathy INR ≥ 1.5
or aPTT > 60 secs

improvesepsis@tmf.org

TMF-CMP-Sepsis-17-14 Published 06/2017

Appendix P

Sepsis tool for Certified Nurse Assistants

If you have identified an important change while caring for a resident today, please encircle the change and discuss it with the nurse/supervisor before the end of your shift.

Name of Resident: _____

Suspected infection and 2 or more SIRS criteria

C – ough
H – ot
A – ntibiotics
D – rainage
WEAK

SIRS CRITERIA: Temperature >**100**
Pulse >**100**
BP **<100** Systolic BP or
>40 Diastolic BP
RR >20 or SpO2 <90%
Altered Mental Status

Respiratory: Short of breath, increasing sputum
Urinary: Frequency, urgency, burning, pain
Neurologic: Headache, stiff neck, light sensitive
Skin: Red, swollen, warm

Staff: _____
Reported to: _____
Date: _____ Time: _____

Appendix Q

Training and SBAR tool Evaluation

Project ID number: _____ **Date**: _____

(Last 2 digits of your phone number + Last 2 digits of your birth year + 2 digits of your birthday. Use leading zero if birthday is from 1-9).

Please rate your level of agreement with the following statements by checking the suitable box.

Questions	Strongly disagree	Disagree	Neither Agree nor disagree	Agree	Strongly Agree
This training will help my organization enhance early identification of sepsis.					
I have a greater awareness of sepsis symptoms, severe sepsis and septic shock.					
I can better recognize which resident is at higher risk for sepsis.					
I understand the treatment of sepsis.					
I have a sense of personal responsibility for improving resident care and outcomes					
I have developed a trusting relationship with my co-nursing staff because of a better communication strategy.					
The SBAR tool helped me communicate better with the healthcare team.					
I will use the SBAR tool to guide my day-to-day communication with the healthcare team.					

- Can you rate your knowledge on Infection control and Antibiotic stewardship?

1 2 3 4 5 6 7 8 9 10

Beginner **Intermediate** **Expert**

Question	Never	Very rarely (once a month)	Rarely (2-3x per month)	Occasionally (2-3x per week)	Frequently (1-2x per day)	Very frequently (more than 2x a day)

How often do you use the SBAR tool?						

What could make this training more effective? (Please print)

_____
_____
_____
_____

Any challenges that you encountered during the implementation of the Sepsis Protocol?

_____
_____
_____
_____
_____

What do you like about the SBAR tool?

_____
_____
_____
_____
_____

What do you dislike about the SBAR tool?

_____
_____
_____
_____
_____

Additional comments

_____
_____
_____
_____
_____

Your voice has been heard! You know that effective communication promotes a safe working environment and successful continuity of care. Again, thank you for your cooperation!

Appendix R

Budget Plan

Phase	Activities	Materials needed	Direct Cost (US $)	Indirect Cost (US $)
Preparation	Design and print promotional materials for the nursing staff (nurses and nursing assistants) for awareness of the project	100 - Printing materials ($0.90 per copy)	90	
		3 – Banner/sign ($20 per pc.)	60	
		20 hours – Labor for Project manager ($30/hr) *based on the average salary of a registered nurse	600	
		1 month - Internet access ($40/mo)		40
		SUBTOTAL	750	40
Delivery	Design and print examination for the nursing staff to determine knowledge on sepsis protocol and antibiotic stewardship (pretest)	200 - Printing materials ($0.90 per copy)	180	
		1 – 18 pens/box	7	

	Create PowerPoint/video presentation for application of Sepsis protocol and antibiotic stewardship	72 hours – Labor for Project manager ($30/hr)	2160	
		8 - Meeting room ($50/hour)		400
		3 months - Internet access for the whole delivery period ($40/mo)		120
	Create educational handouts on Sepsis protocol and Antibiotic stewardship	300 - Printing materials ($0.90 per copy)	270	
	Design and print a laminated ID with information for the nursing staff and a reminder posted in residents' room numbers to know what symptoms to look out for	1 - Laminator machine		50
		200 - Laminating sheets		20
		12 hours – Labor for Project manager ($30/hr)	360	
	Provide a handbook of Sepsis Protocol and antibiotic stewardship for nursing management,	300 – Printing materials ($0.90 per copy) 1 – 3-Ring Binder, 1 Inch - White, 4-Pack to hold the handbook	270 15	

	nurses and CNAs reference.			
	Biweekly meetings with the nursing management and follow up with nursing staff	Travel (20 miles from the Project manager's home to the project site)	500	
		150 hrs - Meeting room ($50/hour)		750
	Design and print examination for the nursing staff to determine knowledge on Sepsis Protocol and AS (posttest)	100 - Printing materials ($0.90 per copy)	180	
	Data collection of infection and antibiotic rate audits from the infection control RN	300 – Printing materials (($0.90 per copy)	270	
		Locked filing cabinet for storage of confidential data		55
		SUBTOTAL	4212	1395

Appendix S

Project Results

Table 1

Demographic Data

Characteristics		All Participants (N=22)
Age (M, SD)		33.33 (10.87)
Gender (N, %)	Male	4 (18.8%)
	Female	18 (81.82%)
Race (N, %)	African American	5 (22.7%)
	Asian	0 (0%)
	Caucasian	10 (45.5%)
	Hispanic	4 (18.2%)
	Native American	0 (0%)
	Pacific Islander:	0 (0%)
	Other:	3 (13.6%)
Marital Status (N, %)	Single	11 (50%)
	Married	9 (40.91%)
	Widowed	0 (0%)
	Divorced	2 (9.09%)
	Separated	0 (0%)
	Living with partner	0 (0%)
Highest level of education (N, %)	Less than high school graduate	0 (0%)
	High school graduate	3 (13.64%)
	Some college, Associate's degree	15 (68.18%)
	Bachelor's degree	4 (18.18%)
	Master's degree	0 (0%)
	Doctoral degree	0 (0%)
	Other	0 (0%)
Nursing position (N, %)	RN	4 (18.18%)
	LPN	6 (27.27%)
	CNA	12 (54.55%)
Employment Status (N, %)	Full time	22 (100.0%)
	Part time	0 (0%)
Work Shift (N, %)	Day	7 (31.8%)
	Night Shift	15 (68.2%)
Years of experience (N, %)	Less than 1 year	3 (13.6%)
	1-3 years	7 (31.6%)
	3-5 years	4 (18.2%)
	6-10 years	3 (13.6%)
	10-20 years	5 (22.7%)
	Greater than 20 years:	0 (0%)

Figure 1

Demographic Data: LTCF provided educational resources about Antibiotic resistance

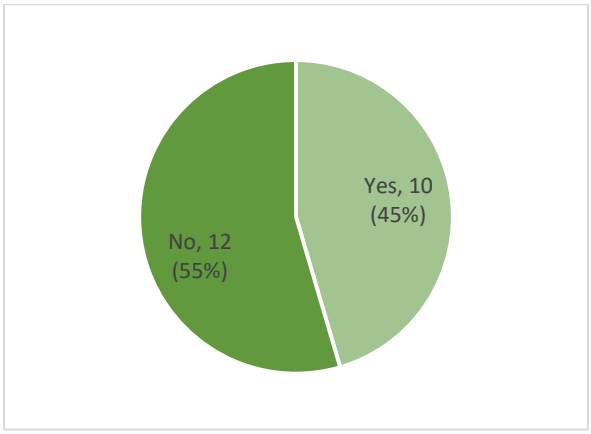


Figure 2

Demographic data: LTCF provided nursing staff opportunities to improve Antibiotic use

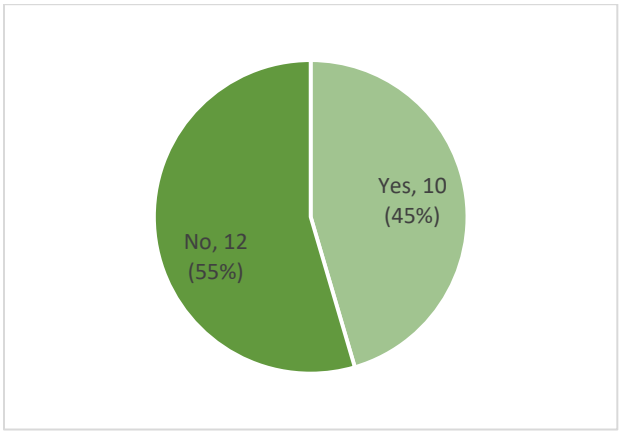


Figure 3

Nurses' Personal Knowledge Rating on Infection Control and Antibiotic Stewardship

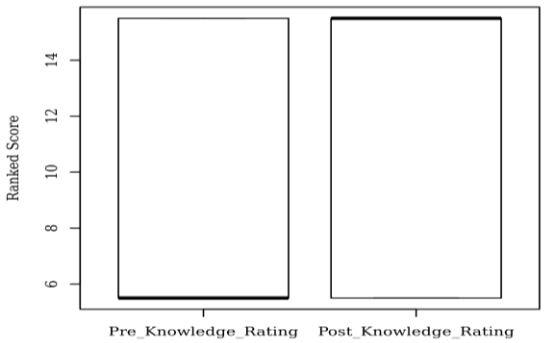


Figure 4

CNAs' Personal Knowledge Rating on Infection Control and Antibiotic Stewardship

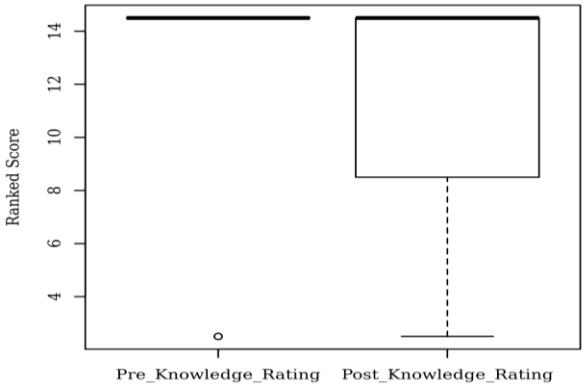


Figure 5

Boxplot of the Ranked Values of Pretest and Posttest Knowledge Questionnaire for Nurses

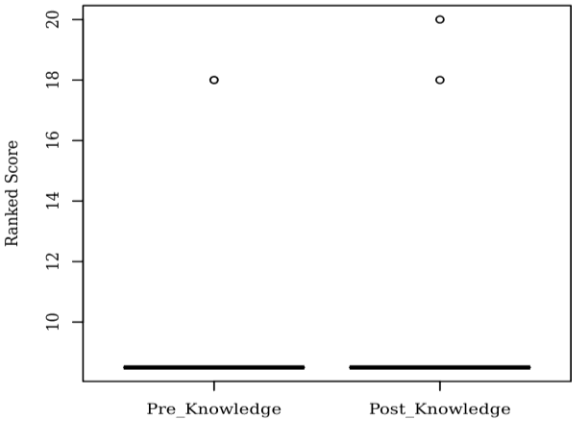


Figure 6

Boxplot of the Ranked Values of Pretest and Posttest Knowledge Questionnaire for CNAs

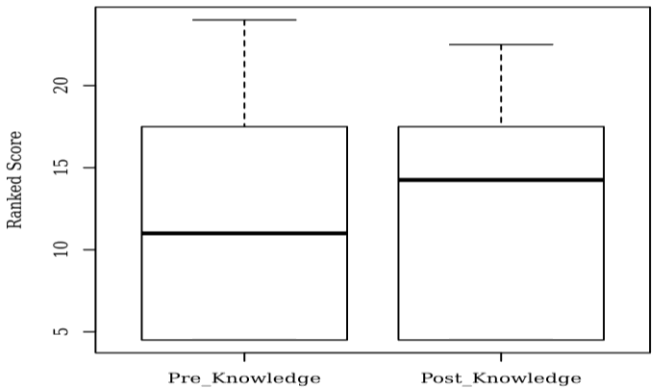


Figure 7

Boxplot of the Ranked Values of Pretest and Posttest Work Relationship Scale for Nurses

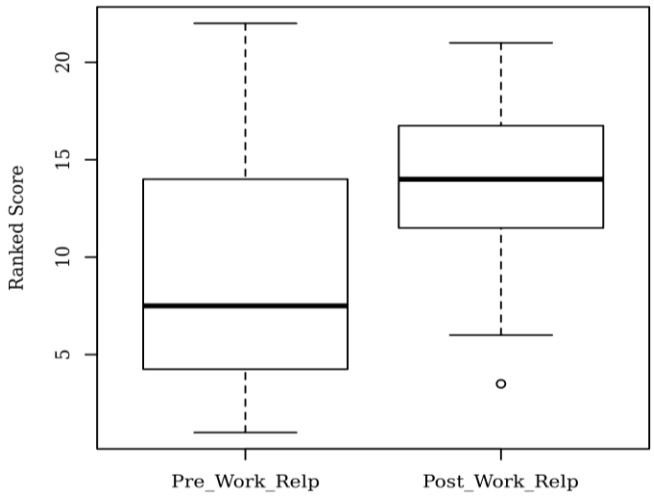
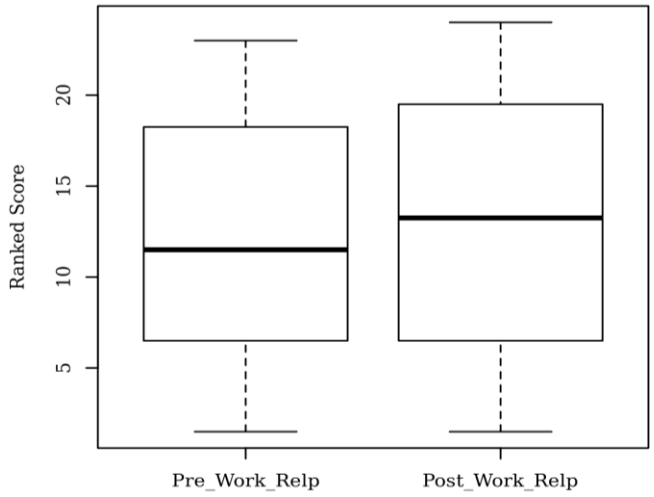


Figure 8

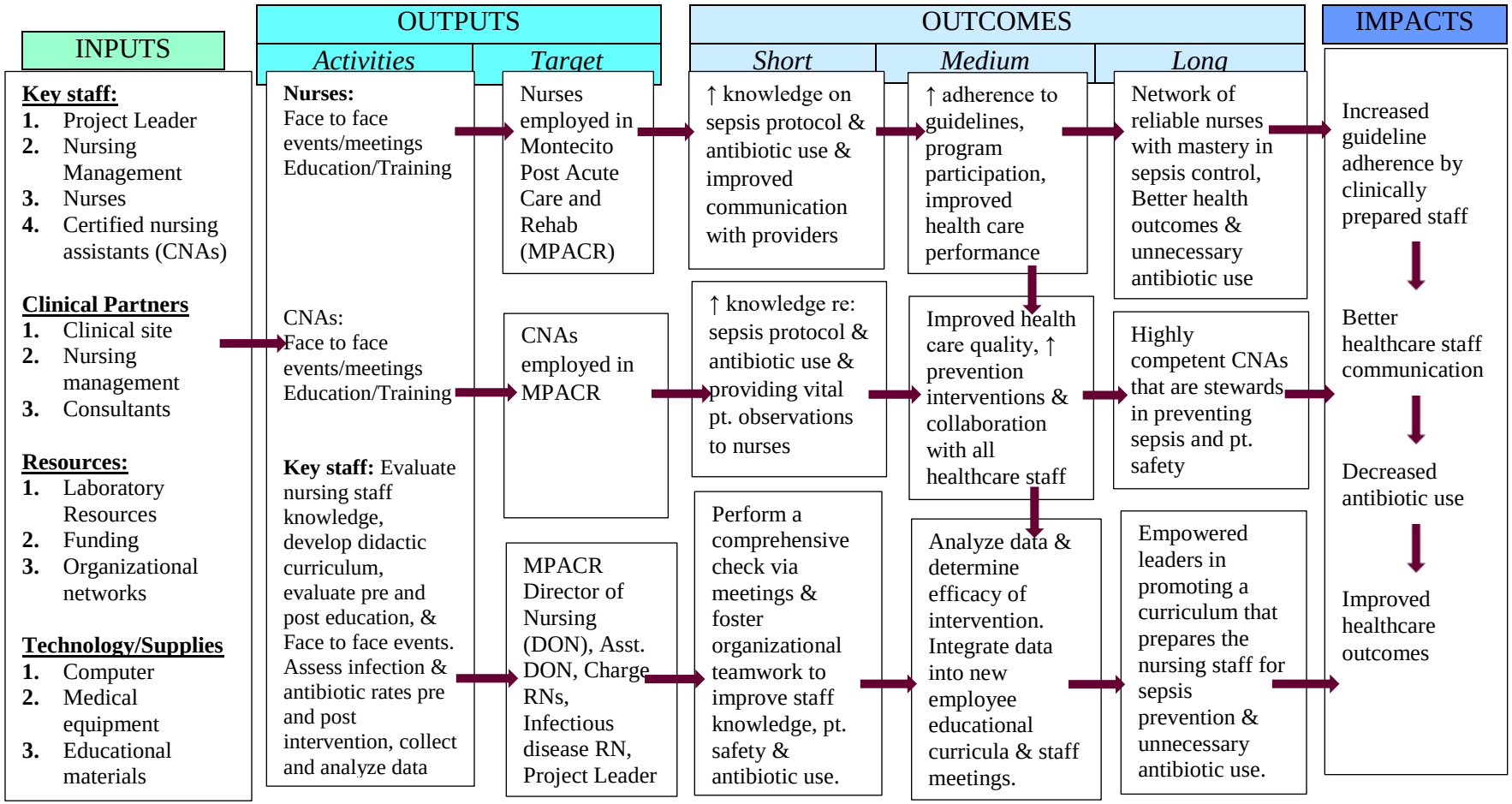
Boxplot of the Ranked Values of Pretest and Posttest Work Relationship Scale for CNAs



Appendix T

Logic Model

Goal: For the nursing staff to increase their knowledge by appropriately using an improved sepsis algorithm.



Assumptions: 1. The inclusion of the healthcare team mainly the nursing staff is vital to attain the full benefit of the chosen Antibiotic stewardship program. 2. Interventions like recognizing signs and symptoms, compliance to guideline-based treatments, education and infection control have exhibited improvement in antibiotic prescribing behaviors, health outcomes, healthcare use, health prevention and increased adherence to recommended treatment guidelines. 3. The nursing management is open for a robust collaboration with the nursing staff to prevent spread of infection. 4. The nursing staff are optimistic in decreasing unnecessary antibiotic use.